TELEPHONE ENGINEER

Volume XVIII CHICAGO, OCTOBER, 19

Your Subscribers
Will Write You
Letters like this
when You Install

AUTOMATIC

the Preferred
Service

AUTOMATIC ELECTRIC CO.
CHICAGO

Makers of Over [illegible] Automatic Telephones in Use

If They're Good Enough for Them

OSHKOSH telephone construction tools are in constant use by hundreds of telephone companies. Repeat orders prove they are giving perfect satisfaction.

The line includes practically everything in telephone construction.

Write *now* for catalogue No. 55.

They're Good Enough for You

OSHKOSH MFG. CO.
Oshkosh, Wis., U. S. A.

Telephone Wire

SATISFACTORY SERVICE DEPENDS
LARGELY UPON
SATISFACTORY WIRING

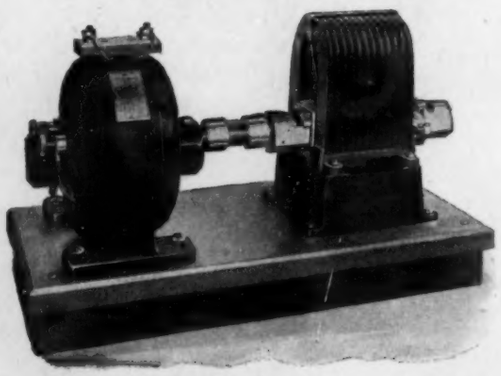
SIMPLEX TELEPHONE WIRE IS APPROVED
BY TELEPHONE ENGINEERS

Samples free

SIMPLEX WIRE & CABLE Co
MANUFACTURERS
201 DEVONSHIRE ST. BOSTON
CHICAGO SAN FRANCISCO

Buy a Holtzer-Cabot Magneto Ringing Motor Generator

And Ring Your Subscribers Without Batteries
You will find it a BETTER WAY



To begin with, war has sky-rocketed the price of batteries.
Then again, run-down batteries are the source of many troubles:
Operators complain that then "can't raise subscribers."
Subscribers complain about "poor service."
The manager spends much time tinkering with the worn-out batteries, and perhaps travels many miles to locate probable trouble in the phone itself—all to no purpose.

Provide yourself with a Strong, Continuous Ringing Current, by the purchase of a HOLTZER-CABOT MAGNETO RINGING MOTOR-GENERATOR.

The Holtzer-Cabot Electric Company

Chicago, Ill. **Boston, Mass.**

AWARDED PANAMA PACIFIC INTERNATIONAL EXPOSITION GRAND PRIZE

W & M Telegraph and Telephone Wire.

Strand and Pole Steps.

Made by
American Steel & Wire Company
Chicago New York Cleveland Pittsburgh Worcester Denver
Export Representative: U. S. Steel Products Co., New York
Pacific Coast Representative: U. S. Steel Products Co.
San Francisco Los Angeles Portland Seattle

STANDARD Telephone Cables

stand for over 30 years of successful experience in the manufacture and installation of electric cables. They represent the greatest advancement in the art of manufacturing telephone cables. Our engineering experience is at your service.
Write our nearest office for "Pointers on Telephone Cable Specifications."

Standard Underground Cable Co.
Pittsburgh, Pa.

Boston Philadelphia Chicago
New York San Francisco St. Louis
For Canada: Standard Underground Cable Co. of Canada, Limited Hamilton, Ont.

PAUL H. WOODRUFF, Editor
New York Representative: CHARLES R. CONDON
New York Office, 1022 Longacre Building
Forty-second St. and Broadway
Telephone Bryant 7030

This publication is free and independent of all business or house connections or control. No manufacturer or supply dealer, or their stockholders or representatives, have any financial interest in Telephone Engineer or any voice in its management or policy.

Entered at Chicago Post Office as Second Class Mail Matter

Telephone Engineer

WITH WHICH IS CONSOLIDATED
The Western Telephone Journal
ESTABLISHED 1902

PUBLISHED MONTHLY BY
ELECTRICITY MAGAZINE CORPORATION
MONADNOCK BUILDING, CHICAGO, ILL.
Telephone: Harrison 3014—All Departments

NOTICE TO ADVERTISERS

Changes of advertising copy should reach the office of publication not less than ten days in advance of date of issue. Regular date of issue, first day of each month. New advertisements will be accepted up to within five days of date of issue, but proof of such advertisements cannot be shown in advance of publication.

SUBSCRIPTION PRICE
Per Year $2.00
Canada $2.50
Foreign 3.00
Single copy 20
FOR SALE AT ALL NEWS STANDS

NOTICE TO SUBSCRIBERS

REMITTANCES — Remittances should be made by check, New York draft or money order, in favor of TELEPHONE ENGINEER. Foreign subscriptions may be remitted direct by International Postal Money Order.

CHANGE OF ADDRESS—The old address should be given as well as the new, and notice should be received two weeks in advance of the desired change.

If Your News Dealer Will Not Supply You—Please Notify Us

VOL. XVIII CHICAGO, OCTOBER, 1917 NO. 4

Don't Postpone the Convention!

THERE is a definite movement among certain members of the United States Independent Telephone Association working for the postponement of the next annual convention. The directors of the association some months ago set the convention date for December 11 to 14. The exponents of commercial diplomacy who are trying to have the date put forward six months or so are calling upon "patriotism" as their reason!

True patriotism demands that the convention be held as soon as possible. The time set by the directors is none too early. Now, if ever, is it essential that Independent telephone men should understand each other—a condition that can be accomplished only by frequent and efficiently conducted get-together meetings. Of all industries it is most emphatically true in this one that business is not "as usual"—and consequently, that operators need all the co-operation they can get.

In spite of the fact that delegates frequently leave conventions with the feeling that they have not accomplished very much, in spite of the apparent waste of time involved in the conduct of all large gatherings, there is no other way to promote co-operation between the units of an industry. They must get together or they will drift apart—a bit of philosophy which sounds like a bull, but is in reality as practical as buying and selling.

Even if the President of the United States had not made it clear to all, in his famous message last June, that business should most emphatically continue its meetings; even if (contrary to the fact) it had been decided by the chairmen of the war committees that trade conventions were an extravagance and a waste; it would still be necessary for the telephone men to get together. The success of the nation is bound up in its telephone wires; and the success of the telephone wires is bound up in the co-operation of telephone men.

It should be clear to the Independent operators that the La Follettes and the Masons and the Thompsons of the telephone industry, who would, if they could, obstruct the progress of Independent telephony, must be actuated by motives other than patriotism or the welfare of the industry. We have intimated more than once that a fairly good imitation of Bell tactics was plainly discernable in the councils of the U. S. I. T. A. We can imagine no move that smacks more of Bell diplomacy than the attempt to postpone the Independent convention.

That such a postponement would operate to weaken the Independent structure at this time must be evident to all who are sincere in their Independence. Never before has the Bell aggregation used the advantage of its unity more vigorously than now. Never has the main Bell office issued so continuous a series of orders and instructions to its subsidiaries. Never has there been so great a need of unification of effort and oneness of operation.

In the midst of this condition these "Independent" obstructionists would prevent, if they could, the only practical expression of the tie that binds the Independent operators together—the only opportunity the Independents have of agreeing to use common methods for a common end. It must be obvious to all that it is far more important for Independents to get together than it is for the Bell managers, who, however widely scattered they may be, are responsible always to a central dictator.

If our opinion were able to influence the handling of the situation, we should advocate semi-annual instead of annual conventions until we came back to "normal times"—if we ever do. An eighteen-month stretch between meetings is intolerable and not to be considered in these times.

And furthermore, those who advocate a postponement of the convention, unless they can show some real logic in their arguments, may well be questioned in all their suggestions.

Leave the convention date as it is—December 11 to 14—solely because it cannot conveniently be set forward to an earlier date. If a meeting in June, 1918, will help, hold it—and another one in December, 1918. That is one way to satisfy the malcontents who insist upon a meeting eight months hence. Let them have it—in addition to the regularly scheduled meeting sixty days from now.

But don't postpone the second annual convention of the United States Independent Telephone Association next December. The trade needs it, if it ever needed a convention.

The Importance of the Depreciation Problem

REGULATION of public utilities, however closely its operation may follow the line of protection of the consumer, must also protect the investor or its work will be destructive rather than constructive. Despite the popular idea of capitalistic ownership of utilities, the actual owners are, to a very large extent, the representative people themselves. They are the ones who benefit or suffer by the decisions of regulating bodies which add to or subtract from the security of their investment.

It is admitted that public utility rates, and particularly telephone rates, still lack a definite basis which will make their calculation an exact science. Operating and maintenance expense are fairly constant figures. Only depreciation and its attendant factors of obsolescence and inadequacy are still flexible because they are still unknown as a mathematically exact charge.

Upon the question of depreciation, therefore, rests the whole problem of profit or loss. With a specific and limited return set upon the investment, inadequate depreciation figures bear a loss to the investor, where correct and therefore adequate depreciation figures would allow a reasonable profit.

One of the greatest weaknesses of the telephone operating industry, both Bell and Independent, has been too low a calculation for depreciation. The habit of ignoring, or at least under-estimating the depreciation item was established before public supervision of public utility operation became the vogue. It becomes evident now that the operating companies would have been safer with an over-estimated depreciation allowance.

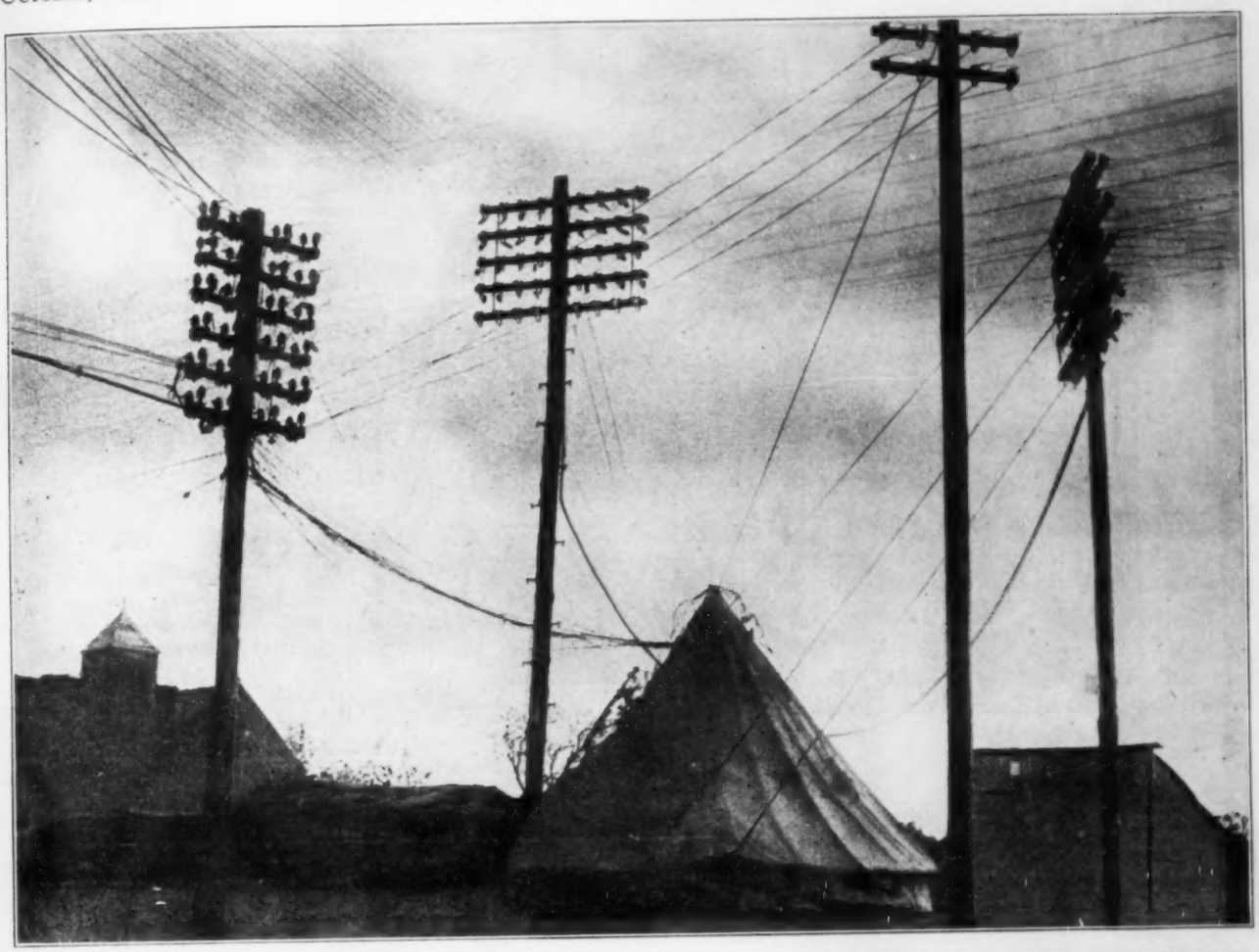
It is a good deal easier to lower a figure than to raise it. But it is a good deal easier to promote a new enterprise if the depreciation factor is ignored—which explains a great deal of the present condition in this respect. Prospectuses which show only a nominal maintenance and operating cost promise considerable returns, or at least ample security, and so encourage stock buying.

If some utilities are now suffering for want of adequate depreciation allowance, they are largely paying for earlier sins. Naturally the innocent must suffer with the guilty, and sins of ignorance are visited equally with sins of intention.

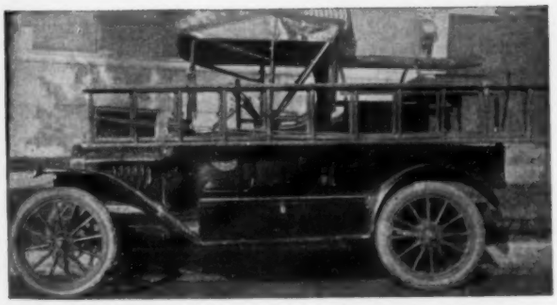
The modern utility operator, and particularly the telephone operator, is as anxious to present depreciation in its correct light as the earlier promoter was to ignore it. The only thing that prevents his accurate recognition of it is the absence of exact information.

Depreciation is a subject upon which every telephone operator should arm himself with information—all the information there is available. Nor should he limit himself to treatises which confine themselves to the telephone industry. The subject is broader than any one line of work. In the electric light, traction and gas industries much thought has been expended upon the depreciation problem which might add considerably to the mental equipment of the telephone man.

A paper on "Theoretical Depreciation," presented for the consideration of the Public Service Commission for the first district, state of New York, has been prepared by James E. Allison, a valuation engineer practicing in St. Louis. The fact that the case had to do with the Consolidated Gas Company of New York does not deprive it of valuable information for telephone men, and it is our intention to present some of its arguments next month.

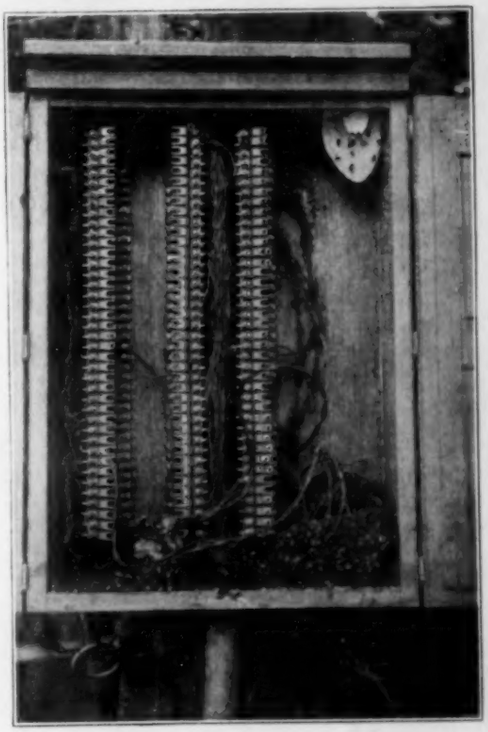


With an immense maze of cables converging on one tents A telephone-testing station behind the British firing-line within shell-range. Lord Northcliffe describes in his book, "At the War," the "unique" telephonic system constructed by the Royal Engineers in France. "The poles and wires," he writes, "are in every way as good as those of the Post Office at home."



The illustration at the right shows a telephone cable box at Port Byron, N. Y., in which a colony of bees began work. Instead of saving this valuable asset "poisonous gas" was used for their extermination by C. W. Weston, manager of the Port Byron Telephone Company.

A pair of Ford chasses adapted to telephone work. At the left top, is a detachable body built and slipped on the back of a Ford roadster. Below it is a made-over Ford that has a place for everything. Both are in the service of the Bell Company at Kansas City, Mo., and the cuts were borrowed from the Southwestern Telephone News.



STORIES IN PICTURES OF TELEPHONE PRACTICE AND PROGRESS IN ALL PARTS OF THE WORLD.

Two-Day Convention in Indianapolis

Expressing the hope that their deliberations might result in better service for the people of the state and in producing more money for themselves, Ele Stansbury, attorney-general of Indiana, delivered an address welcoming the Indiana Independent Telephone Association at the opening of its eleventh annual convention at the Claypool Hotel in Indianapolis, September 19. The convention was called to order by Hart F. Farwell of Terre Haute, the president. It will be in session two days.

William Fortune, president of the Indianapolis Telephone Company, replying in behalf of the telephone men, said that in the commercial world the independents, who represent the democracy of industry, have a fight similar to the great battle of the world against autocracy. This fight, he said, must be determined after the world war is settled. Mr. Fortune declared that the independent telephone men, in their eagerness to give service, were operating under inadequate rates, with the result that with the increased cost of operation few companies were making money. He expressed the hope that the state public service commission would take cognizance of this situation.

E. B. Fisher of Grand Rapids, Mich., reviewed the development of the business. The future, he said, was uncertain because of the possibility of the government taking over all lines for the purposes of the war. He told of the important work being done in war by the telephone. His address closed the morning session.

The afternoon was taken up with committee meetings, appointment of committees and organization of the convention.

An address late in the afternoon by J. W. Coffey on "Accounting and the Making of Reports," and a discussion, led by Samuel Tomlinson of Plymouth on "Meeting Increased Costs," were heard with interest.

In the Riley room at 7 p. m. about 300 members of the association and visitors attended a banquet. William Fortune of the Indianapolis Telephone Company acted as toastmaster, and Edgar A. Guest, a newspaper man of Detroit, made the principal speech, reciting a number of original poems. Brief talks also were made by E. B. Fisher of Grand Rapids, Mich.; Fred Landis of Logansport; G. R. Johnston of Columbus, O.; W. S. Vivian, secretary-treasurer of the United States Telephone Association, and H. M. Friendly of the Indianapolis Telephone Company.

A feature of the convention of particular interest was the school of operators on the ninth floor. Approximately 150 operators from Indianapolis and other cities of the state attended. Lectures were given and the operators were required to give practical demonstrations over temporary switchboards.

At the morning session Thursday addresses were made by J. K. Johnson on "Courts and Commissions"; J. G. Mitchell on "Underlying Principles in the Design of Telephone Protective Apparatus," W. F. Benoist on "Automatic Telephone Development" and Kurt C. Barth on "Pole Preservation."

Samuel R. Artman opened the afternoon session with an address on "Experiences in the Administration of the Indiana Workmen's Compensation Act"; Lynton T. Block spoke on "Indemnity Insurance Legislation" and R. H. Manson, chief engineer of the Stromberg-Carlson Telephone Manufacturing Company, "Telephone Transmission," which is published in this issue. The reports of committees and election of officers concluded the convention.

Thursday afternoon the following officers were elected: Frank E. Bohn of Ft. Wayne, president; H. T. Hosea, Indianapolis, secretary-treasurer; S. M. Isom Mitchell, first vice-president, and Sam Tomlinson, Plymouth, second vice-president.

Directors were elected as follows: W. M. Bailey, Richmond; J. A. Browne, Winchester; H. F. Farwell, Terre Haute; William Fortune, Indianapolis; W. W. Harbaugh, Sullivan; N. R. Lehr, Tipton; F. R. Parrott, Princeton; C. R. Stoops, Nappanee; F. R. Stickler, Franklin; Walter Uhl, Logansport, and Lloyd Christly, Boswell.

Resolutions expressing sympathy for Governor Goodrich in his illness and indorsing the government's methods in prosecuting the war were adopted. A resolution was adopted calling on the directors to use their power to secure increased telephone rates.

Kansas Headquarters for Bell

Effective October 1, division headquarters of the Southwestern Bell Telephone Company for Kansas will be established at Topeka, it was announced by E. D. Nims, first vice-president of the company, with headquarters at St. Louis. This means that the Southwestern's business in Kansas will be under the supervision of a general manager in Topeka. This announcement, coupled with the fact that last January the Southwestern purchased four lots adjoining its present headquarters, 812-14 Jackson street, brings indications that the company is planning extensive enlargements of its interests in Topeka to almost a reality.

Between twelve and fifteen large office rooms will be necessary to house the new general manager's force which will be brought here.

Those in close touch with the Southwestern's interests in Kansas believe the company is planning the material enlargement of its present headquarters building by erecting an addition, or possibly a new building, costing several thousand dollars, on the lots purchased last January. When this is done more offices of the company would be brought here.

Vice-President Nims stated that the difficulties encountered by the telephone company in the operation of its property due to the unusual demands made upon its organization and the requirements which the company has to meet, both from the government and the general public, coupled with increased costs of rendering service under the present conditions, has made it imperative for the company to establish this direct and local supervision

Conferences in Ohio in October

Frank L. Beam, president of the Ohio Independent Telephone Association, announces that conferences of Independent telephone managers and officials from several sections will be held in October. Among the topics to be discussed are: The effect of war taxation law upon the telephone industry; the furnishing of preferential telephone service to the United States government, and the tremendous increase in the price of all telephone materials. Preliminary reports to Mr. Beam indicate extensive gains by the Independent telephone companies of the state during the past year. Conferences will be held at Cleveland October 2, Toledo October 3, Lima October 4, Dayton October 5, Canton October 10 and Columbus October 12.

Value of Articulation in Transmission

Presented at the Convention of the Indiana Independent Telephone Association

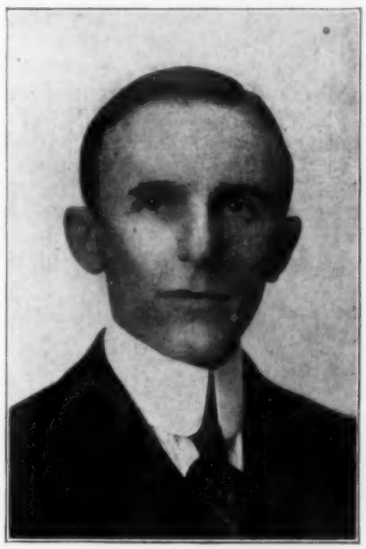
BY RAY H. MANSON

OBVIOUSLY the foremost mission of a telephone system is the transmission of sound, faithfully and with sufficient volume or loudness to be easily heard.

The path of the sound energy, from the telephone transmitter to the distant receiver is strewn with practical difficulties which tend to prevent perfect sound transmission.

It is well that the unavoidable defects in transmission are not realized by the telephone user. This is due to the fact that in the understanding of a message, great dependence is placed on context.

The difficulty in understanding of proper names, unfamiliar words and figures, often causes the telephone user to wonder what is wrong. It does not take long distance conversation to show up these defects in transmission, for they can be due to peculiarities in the transmitter, receiver or to the apparatus in the connecting circuit, all of which can be sufficiently pronounced to affect the ordinary city conversation.



Ray Manson, Chief Engineer of the Stromberg-Carlson Telephone Manufacturing Company.

The following results of a carefully made test will serve as an example of the "loss of understanding," due to defective articulation of a particular design of transmitter.

Like many other transmission tests the results can be expressed as a loss of so many miles of standard artificial cable, and then interpreted as a handicap of so many miles of actual copper line added to an otherwise good circuit.

Two different designs of commercial transmitters were selected by comparison so as to have instruments giving equal volume of transmission. These will be designated as Transmitter No. 1 and Transmitter No. 2.

While the volume of transmission from the two instruments were exactly the same, the average user would probably pick No. 2 as having a more "rounded" or "fuller" tone. However, when a careful articulation test was made, it was found that the No. 1 transmitter had to be handicapped by adding two miles of standard artificial cable to its circuit, in order that the understanding of the transmission be of the same value as the No. 2 transmitter. In other words Transmitter No. 1 was capable of talking with equal understanding with Transmitter No. 2, when used on a No. 12 copper line twenty-five miles longer.

This articulation test was made as follows: A standard test circuit condition was set up as in diagram Fig. 1, a fixed amount of standard artificial cable being included in the test line so as to avoid errors due to circuit conditions, as well as to reduce the volume of transmission to a degree where it was easily comparable. Then an adjustable standard artificial cable was arranged so as to be added in circuit with either one of the transmitters under test, to serve as a handicap for the best instrument and to balance the circuits, so that the understanding from both transmitters was the same for the listener at the receiving end of the test circuit.

In conducting the test a large number of letters, unfamiliar words and figures were spoken into each transmitter in turn and records thereof made by the listener at the receiving end for each instrument. The transmitter having the least number of errors scored against it was handicapped by adding of the adjustable standard artificial cable and the process repeated until errors due to misunderstanding were equal in the two transmitters.

Several speakers and listeners were used, the results being averaged so as to reduce the chance for error, due to personal deficiencies of talking and hearing of the persons conducting the test.

It is interesting to note here that the taking of the readings alone in a simple transmission test of this kind, represent a day's work for a number of experienced men. This is after going through the preliminaries of selecting representative transmitters from a large number of each of the types under consideration.

Another example of a handicap to the understanding of telephonic transmission is shown by a test involving a comparison of two well-known common battery substation circuits.

One of these circuits, designated in the tests as Sub-Station No. 1, is now furnished on order, by all large manufacturers of telephone equipment.

The other circuit, designated as Sub-Station No. 2, is used as a standard by many operating companies.

When the two sub-station circuits were compared for volume of outgoing transmission, using the same transmitter and receiver, so as to have only one variable, Sub-Station No. 1 was approximately two and one-half miles of standard cable better than Sub-Station No. 2. This is equivalent to about thirty miles of No. 12 copper wire line.

One of the most noticeable characteristics of Sub-Station No. 1 is the excessive side-tone produced in the receiver of the telephone when talking into its transmitter. The amount of talking current producing this side tone was determined by careful laboratory measurements to be approximately 500 per cent greater than for Sub-Station No. 2.

It is natural to expect that such a loud side tone would be disagreeable when the receiver is held tightly to the ear, and that an increased numbing action of the organs of hearing would result. This was found to be the case.

The numbing effect in question is the same as that experienced after being in a factory room where excessive machinery noise is present. Immediately upon

emerging from such a noisy room, it is necessary to talk to such a person in a tone of voice louder than normal, to overcome the deafening action. Ordinarily this effect quickly disappears, the sensitiveness of the ear then returning practically to its orinigal condition.

A very interesting test was made to determine the amount of this increased numbing effect on the ear of the user of Sub-Station No. 1, when carrying on a long distance conversation. The conditions of test were so

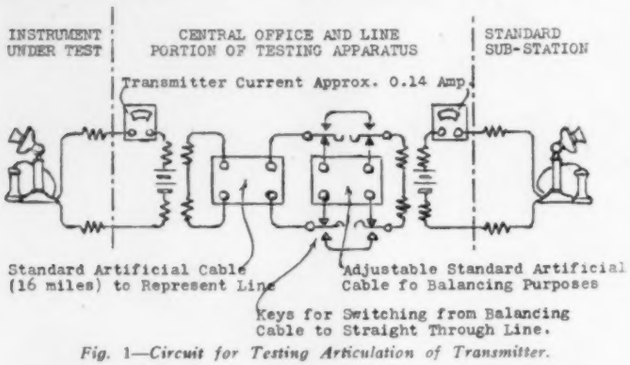

INSTRUMENT UNDER TEST
CENTRAL OFFICE AND LINE PORTION OF TESTING APPARATUS
STANDARD SUB-STATION
Transmitter Current Approx. 0.14 Amp.
Standard Artificial Cable (16 miles) to Represent Line
Adjustable Standard Artificial Cable fo Balancing Purposes
Keys for Switching from Balancing Cable to Straight Through Line.

Fig. 1—Circuit for Testing Articulation of Transmitter.

arranged that the net results of the deafening effect was shown as an increase in the length of the line, and expressed in terms of standard artificial cable.

For this side-tone test a standard circuit was arranged, as in Fig. 2, a fixed amount of standard artificial line being included in the circuit to avoid transmission errors which can exist on a shorter length of test circuit and to reduce the volume of transmission so as to approximate that received over a long distance circuit. An adjustable standard artificial cable was arranged to be cut in or out of the line circuit for balancing purposes.

It will be noticed from the diagram that three persons are required for conducting the test, the "observer" being located in a sound-proof booth and the "reader" and "side-tone producer" in separate rooms.

The duty of the "reader" was to talk distinctly and in a "long distance" tone of voice into the transmitter of the telephone at the distant end of the test line, reading from a printed sheet. The "observer's" interpretation of the incoming transmission was recorded and the two lists compared for errors.

Now, in order to get the side-tone effect in the receiving instrument, which would be present in a regular long distance conversation, due to talking into the transmitter, and without calling on the "observer" to perform any disturbing duties, the third person, called the "side tone producer" talked a few words every few seconds into the transmitter of the receiving station. The "reader" was provided with a signal so as to stop talking when the side-tone was produced and so as to resume talking immediately thereafter, so as to approximate the average condition of a long distance conversation. The observer made no records of the words or sentences used in producing the side-tone.

A large number of tests were made on this circuit condition and with several observers, the results being as follows:

Test of Sub-Station No. 1: The numbing effect caused by the side-tone of this circuit was productive of the same number of errors in receiving as when receiving without side-tone and with a handicap of approximately three miles of standard artificial cable added to the transmission line. In other words, the damaging effect of the side-tone was equivalent to adding of about thirty-seven miles of No. 12 copper wire line to the circuit.

Comparative Test of Sub-Station No. 1 with Sub-Station No. 2: The errors in receiving, caused by side-tone in Sub-Station No. 2 required the addition of approximately one mile of standard artificial cable for balancing with the errors of Sub-Station No. 1, under the same conditions of test. Stated in another way, Sub-Station No. 2 is twelve miles of No. 12 copper wire line more efficient than Sub-Station No. 1.

Now, the test for "volume of outgoing transmission" previously given, shows Sub-Station No. 1 to be superior to Sub-Station No. 2 by approximately two and one-half miles of standard artificial cable, therefore the relative effective transmission values of the two sub-stations have reversed and can be expressed as follows:

(a) For volume only, Sub-Station No. 1 is better than Sub-Station No. 2 by approximately 2½ miles of standard artificial cable or 30 miles of No. 12 copper wire line.

(b) The net effective transmission value of Sub-Station No. 2 (taking into consideration the numbing effect) is better than Sub-Station No. 1 by approximately 1 mile of standard artificial cable or 12 miles of No. 12 copper wire line.

Therefore, Sub-Station No. 1 has lost, due to numbing effect, approximately three and one-half miles of standard artificial cable, or approximately forty-two miles of No. 12 copper wire line.

There were several interesting facts noted in this side-tone test, as follows:

(a) With this side-tone test, most of the errors of recording, immediately succeeded the production of the side-tone, while the errors made in recording the transmission without side-tone were more evenly distributed, proving that errors were caused by the deafening effect.

(b) With most observers, the numbing effect gradually disappeared in a few seconds after the production of the side-tone, the ear, therefore, being nearly restored to normal sensitiveness.

The values given for the side-tone test are not submitted as absolute, being only for a particular set of

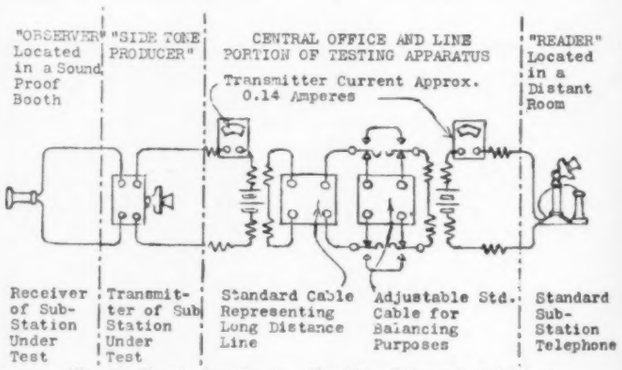

"OBSERVER" Located in a Sound Proof Booth
"SIDE TONE PRODUCER"
CENTRAL OFFICE AND LINE PORTION OF TESTING APPARATUS
"READER" Located in a Distant Room
Transmitter Current Approx. 0.14 Amperes
Receiver of Sub-Station Under Test
Transmitter of Sub Station Under Test
Standard Cable Representing Long Distance Line
Adjustable Std. Cable for Balancing Purposes
Standard Sub-Station Telephone

Fig. 2—Circuit for Testing Numbing Effect of Side-Tone.

conditions which were taken as representative of a long distance conversation. These values would vary somewhat, depending on the various conditions which would obtain in practice.

These side-tone tests were made with the receiver held tightly to the ear, the same as is necessary sometime during every long distance conversation. If long distance conversations are sufficiently deliberate the receiver can be removed from the ear each time the transmitter is talked into, then this numbing effect of side-tone is obviated.

In conclusion, there is one point the writer wishes to emphasize, that there seems to be too much dependence placed on merely volume of transmission without considering other collateral causes which modify the effectiveness of volume.

Improvements in the Radio Telephone

De Forest Brings Out New Type of Audion Instrument

BY FRANK C. PERKINS

A TYPE of radio telephone distinctly different from all earlier types and making in every particular, from principle to detail, a great advance, may be seen in the accompanying illustration. The naval and military service of the United States is now in need of every means of communication possible. In these various radio telephone instruments simplicity of operation and greatest possible freedom from adjustment have been carefully sought, and the present device can be easily manipulated by any intelligent person who follows the very few instructions which are needed.

The arc used in previous types has been completely eliminated. The generator of the high frequency currents is a modification of the now famous audion which has been in use for years in the commercial wireless stations. The bulletin of the United States Bureau of Standard shows that the audion is fully 50 per cent more sensitive than any other known form of detector. Its use has doubled the receiving range of wireless equipment during the past few years. It is employed almost to the exclusion of other detectors by the United States navy. The audion is the one device, above all other factors, which made possible telephony from coast to coast on the Bell telephone system.

It may be stated that a form of this device has been developed into a generator of high frequency currents for telephoning without wires, for its constancy and thorough reliability are its distinguishing features and these are absolutely essential in a practical commercial wireless telephone.

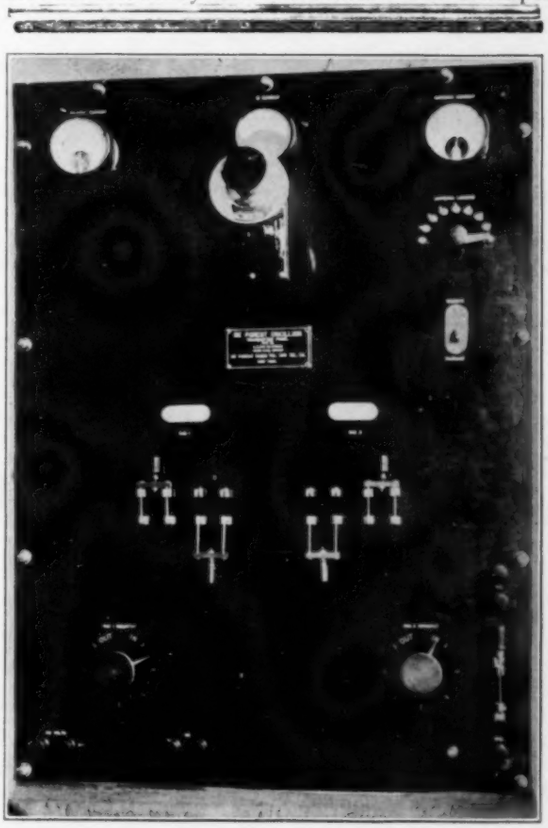
In one form of transmitter, all the instruments are mounted on a panel of Formica measuring 11 by 13 inches, including oscillion bulb or tube, potentiometer for close regulation, filament rheostat, impedance coils, loading inductance, telephone transformer coil, microphone transmitter, fixed condenser and minor accessories. With the set a battery delivering 150 to 300 volts is required. This is composed of flashlight cells, or a motor generator is used where the set is to be operated a great deal. The filament works from a small storage battery and a variable condenser in oil is needed also and is connected to binding posts.

The apparatus has proved thoroughly reliable. When once properly installed and adjusted it is simply necessary to turn on the power and throw the transfer switch to one position for talking and to the other for listening. The transmission of speech is perfect. It is at least as clear and distinct as that over a wire telephone line if not more so.

The experiments conducted at the naval station at Arlington (Washington, D. C.), whereby speech was transmitted to Paris, San Francisco and Honolulu, were carried out in this same system. This speaks volumes for the range and clearness of speech. The apparatus is compact and comparatively inexpensive, from the standpoint of initial and operating costs.

Where electric power is available, the radio telephone set is operated from it by means of a motor-generator. The consumption of power is low and entirely within the capacity of any standard electric lighting plant. Where no electric power can be obtained a small gasoline engine is used, connected to a generator either directly or by belt. Among the applications some of the most interesting include its use for yachts and house boats. The radio telephone enables the captain or owner to talk to the home, club house, or to other craft, saving time and obtaining an instant reply. It is useful for all classes of commercial ships, barges, tugs and lighters. The captain can be in touch with the office and passing ships and no special operator is needed.

For intercommunication between islands and with the main land, along the Carolina and Florida coasts, in Delaware and Chesapeake Bay, and Thousand Islands, etc., apparatus is now available. For revenue service, coast and inland surveys, forestry, the radio telephone has a large field. For connecting offices and factories where wire telephone tolls are excessive or service unreliable it has a further use.



Complete Wireless Telephone Equipment

For emergency or regular service by electric transmission companies to insure communication between generating and sub-stations and switching points at all times, and for communicating on railroads between towers and moving trains, this set will be of immense service where unnecessary stopping of trains is an item of importance.

It is desired now to introduce the radio telephone for river work as on the waters of the Mississippi and tributaries, not only for steamboats where it is a convenient or a genuine economy for the captain to talk direct to a landing station or another boat long before his arrival or passing, but between small towns and stations on opposite banks between which there is no telephone cable.

One of the radio telephone

outfits of the general design is shown in the accompanying photograph. The radio telephone transmitter panel measures 18 by 24 inches. Upon it are mounted the various parts; all of which except the transmitter arm, the loading and inductance switch, the variable condenser knob, and meters are mounted on the rear. This protects the parts and simplifies the operation. On the rear are placed the large oscillion bulb or tube with its cooling fan, the loading coil, telephone transformer coil, variable condenser, impedance coils and minor accessories.

There are ammeters on the front to enable operation at highest efficiency, one showing the filament current and the other the radiation. By this the operator actually sees himself talk, for the speech causes corresponding deflections of the pointer, showing at all times the condition of the set as a whole.

With some of these sets a motor generator is used, designed to operate on any available electric circuit. This furnishes 1,200 volts direct current to the oscillion. A small type of radio telephone has successfully transmitted speech over a distance of 100 miles, in connection with an antenna 300 feet high. With a lower antenna, the range would, of course, be less. The set is arranged so that it may be employed also as a wireless telegraph transmitter of continuous waves. Its range when so used is from two to three times the telephone range, where the "ultraudion" detector is employed at the distant station.

With this transmitter it is only necessary to connect the antenna and ground to the proper binding posts, connect to the 110-volt direct current source and to the generator and the set is ready to operate. When 110 volts direct current is not available a second generator is provided directly connected to the motor of the motor generator. For telegraphing where a crystal detector or a plain audion detector is used at the distant station, a chopper or whistling circuit is supplied, so that the signals may be received. But it is always recommended, on account of the greatly increased range, to transmit undamped or continuous waves and equip the distant station with the utraudion detector or receiving cabinet.

When this transmitter is adjusted to the desired wave length no further change is required, it being merely necessary to throw the transfer switch from talking to listening or vice versa.

There has been developed for radio telephone service a larger panel than the above transmitter which is equipped with two oscillion bulbs or tubes having a cooling fan common to both. The output is approximately 200 watts into an antenna of reasonable size. The motor generator is also of larger capacity, delivering 1,500 volts to the bulbs or tubes.

With a suitable antenna this telephone range is from 150 to 200 miles over water and the telegraph range about twice to three times this where the ultraudion detector is employed at the distant station. It may be used either as a telephone or a telegraph, and where a crystal detector is employed at the distant station the transmitter is equipped with a chopper or whistling circuit. The De Forest audion amplifier is used in connection with the audion detector and amplifies the sound of the received voice, or signals, from 5 to 1,000 times, depending on the type.

This device increases signals of small intensity with absolute fidelity and without lag or distortion, and is thoroughly reliable. Where a greater volume is desired than the radio telephone sets provide, or where the distance between stations is greater than the range of the set alone, the amplifier will enable the desired results to be obtained.

Vessel owners generally admit the advantages, if not the necessity, of wireless communication, but the majority object to the standing expense of morse telegraph operators on each ship. The waters of the Atlantic Coast and tributaries teem with craft for which the radio telephone offers a mode of signal and voice transmission of inestimable value, both for safety and the expedition of business.

There is no question that an immediate field for marine radio telephone development is the need now felt by transportation and towing companies around our seaports for communication from large offices to the various tugs or lighters in adjacent harbor waters. Owners of private yachts and house-boats find radio telephone equipment a great convenience for their craft, so as to be in communication with club houses, shore homes, passing ships, or with any of the numerous wireless telegraph stations along the coast.

The radio telephone has sufficient range, as at present developed, to fulfill all general requirements and vessels so equipped can communicate with each other and with shore stations, in the transaction of commercial business, and be warned of a vessel's approach in fog or storm, and avoid disaster. They can pass within range of any wireless telegraph station and report themselves or deliver a message, getting the simple "ok" morse signal in reply, even if no telegraph operator is aboard. On all ships there is usually someone, or several, who have or will quickly pick up and be able to use the morse code with fair accuracy.

The words transmitted by the radio telephone can be received at any wireless station and conversely, the wireless telegraph signals may be received at a station equipped with radio telephone. This enlarges the field of the radio telephone enormously. The radio telephone is equipped with an audion receiving cabinet which permits reception of time signals, weather and press reports and other messages of interest, transmitted by wireless telegraph.

Compared with the ordinary wireless telegraph, the radio telephone can transmit from five or ten times as many words per minute. As regards its ability to work through adverse interference, static disturbances, the radio telephone is actually superior to the wireless telegraph. The British Admiralty tests demonstrated this particularly. Such a percentage of accuracy, for example, as that of only two errors out of a list of 154 numbers (some five and six figures), at a distance of 50 miles, through severe interference, would have been impossible by means of the spark telegraph. It may be mentioned that to replace flag-signaling at sea the radio telephone, calling off merely the numbers of the code signals used, has clearly demonstrated its great merit, and this for distances ten times those possible by visual signaling, through fog, smoke, or foul weather, by night as well as day, and with a hundred-fold greater speed.

Toledo Gets New Exchange

The Central Union Telephone Company is planning the erection of a fireproof exchange at Geneva and Arlington avenues, Toledo, O.

It will represent an outlay of $110,000, with an additional expenditure of $60,000 for outside connecting facilities, District Manager A. J. Mellen announces.

It will be known as the Broadway exchange and will substitute for the temporary exchange at South and Hawley streets. It will have an ultimate capacity six times that of the temporary Broadway branch.

Telling the Public How

With Special Reference to a Booklet Prepared by the Southern Bell and Cumberland Companies

INASMUCH as the telephone is a device intended solely for the use of the public, which knows and cares nothing about the methods of its efficient operation, a great deal of time and labor loss is directly chargeable to ignorance on the part of those most concerned. Any attempt, therefore, to instruct the public in more careful and judicious use of the telephone privilege is a direct benefit to the operating industry.

The treatise on "How to Use the Telephone" which is reproduced to form this article was prepared by the Southern Bell Telephone and Telegraph Company and the Cumberland Telephone and Telegraph Company at their offices in Atlanta, Ga. In explanation of this work, the companies say:

"There is one best way to do everything, even if it be but to boil an egg. There is a best way to use the telephone, although it is ordinarily considered so simple a thing that even a child can successfully make use of it.

"The purpose of this pamphlet is to set forth in considerable detail the whys and wherefores of telephone usage for the benefit of telephone users generally but for young people being schooled in business methods particularly.

"Commercial high schools, business colleges and office work schools conducted by business concerns, will find this pamphlet helpful in teaching the use of the telephone in accordance with the best business practice.

"It is recommended that this pamphlet be used as a lesson sheet in the class room. The telephone company will furnish without charge as many of them as can be used to advantage. Ask for educational pamphlet No. 1.

"The telephone company will gladly send some one to lecture to the class on the use of the telephone and afterwards to conduct it on a tour through the telephone central office."

SOME SUGGESTIONS TO BUSINESS MEN AND WOMEN ON THE BEST WAY TO HANDLE BUSINESS BY TELEPHONE

Three persons enter into every telephone connection: you, the telephone operator at the central office, and the person called. If each of these three does his or her part correctly a successful connection will result; on the other hand, the failure of any one of the three to observe the proper procedure is likely to be the cause of annoyance and loss of time.

Here are some suggestions that will explain the best way to use the telephone so that you can do your part, and know what is expected of the other two persons that participate with you in the handling of business by telephone.

Consult the Directory.—It is important to begin everything right, especially a telephone call; so, in making such a call, the first thing to do is to make sure that you have the right number. The only way to do this is to get the number from the telephone directory.

A Telephone Number is made up of a central office name, a number and a party line letter; for example, Hemlock 1234-J, Hemlock being the name of the central office to which the telephone is connected, 1234 being its number and J being the party line letter.

The central office name is as important as the number itself, for without it the number is incomplete and meaningless, likewise if the telephone is on a party line the letter is necessary to distinguish it from some other telephone on the same line.

If the central office name, or the party line letter, where the telephone is on a party line, is not given the operator must refer the call to a special operator called "Information," provided you do not supply the omission when the operator asks for it.

Where there is but one central office in the city a central office name is not necessary and is therefore not used as a part of the number. Where there is but one telephone to a line the party line letter is not used.

Pronouncing Numerals.—It is important that the digits composing the number be distinctly spoken, because there is danger of mistaking one number for another. So many numbers sound alike, when spoken carelessly over the telephone that it is necessary to particularly emphasize the ones that are most frequently confused. For example, 0 sounds like 4, 2 sounds like 3, and 5 sounds like 9.

Telephone operators are taught to pronounce numbers in this manner:

1—"Wun"—with a strong N.
2—"Too"—with a strong T and long OO.
3—"Th-r-ee"—with a slightly rolling R and E.
4—"Foer"—one syllable, with a long O.
5—"Five"—with a long I and strong V.
6—"Six"—with a strong X.
7—"Sev-en"—with two syllables.
8—"Ate"—with a long A and strong T.
9—"Nien"—one syllable with a strong N on the end.
0—"Oh"—with a long O.

In calling a number it is best to divide it into two parts, like this: One two (pause) three four. This method of calling greatly assists the operator in understanding the number correctly.

Put the Lips Close to the Mouthpiece.—To get the best results, speak directly into the transmitter and have the lips within half an inch of the mouthpiece. The telephone is designed to be used in this way and will not give satisfactory results if the conversation is carried on with the mouth four or five inches from the mouthpiece.

To avoid mistakes the operator is required to repeat the number called as she understands it. It is, therefore, important when she makes this repetition that you acknowledge it by saying, "Yes, please," or by correcting her if she makes a mistake.

Beginning the Conversation.—When someone answers the call, ask for the office or person wanted, or state your business to the person answering. It is not necessary to inquire "What number is this?" before beginning the conversation.

If you wish to speak to some one other than the person answering, use the expression "May I speak to Mr. Roe, please?" If it is necessary that the person answering should know your name in advance, introduce yourself by saying, "This is Mr. Blank," and if a further explanation is necessary, say "This is Mr. Blank, of Smith, Jones & Company."

It is not courteous to demand the name of the person answering until you have identified yourself. If it is necessary that you know the name of the person answering, say "This is Mr. Blank; who is this speaking, please?"

Leaving Word.—Should you fail to reach the desired person and wish to leave word for him to call you, it is important that you give both your name and your telephone number, in order that the person that gets the memorandum may know what number to call and for whom to ask. The best expression to use in such a case is, "Please leave a memorandum for Mr. Doe to call Mr. Blank, at Main 456."

If you leave the name only without the number, you put upon the person called the trouble of looking up your number, and it is possible that he may not be willing to take this trouble. If you leave the number without the name, he will not know whom to ask for when he calls your number.

Ending the Conversation.—It is just as important to end the conversation properly as it is to begin it properly; therefore make sure that the person called understands that you have finished your part of the conversation. This is usually done by saying "good-bye" or by using some similar expression. If the person called is left in doubt as to whether you have completed your part of the conversation when you hang up your receiver, he may ask the operator to re-establish the connection, thinking that he was "cut off."

Second Calls.—After the operator has answered you and you wish to attract her attention, move the receiver hook very slowly up and down. This opens and closes an electrical circuit which operates apparatus at the central office, which flashes a tiny electric light before the operator. If the hook is moved rapidly, the apparatus does not respond and the operator will not know that you are trying to attract her attention.

This same method should be followed when you want to communicate with the operator after she has established the

connection and also when you have finished one conversation and wish to call another number. It is quicker and more satisfactory to attract the attention of the operator on "second calls" in this way than to hang up the receiver, wait a while and then remove it and call the other number.

Waiting on the Line.—It is not considered good telephone practice, nor even polite, to call a person and say "Is this Mr. Doe? Hold the line, please," and then leave him waiting until some one is ready to talk to him. If anybody is to be kept waiting the person making the call should be the one. However, if someone insists on your getting another person on the line for him, in doing so say "Is this Mr. Doe? Mr. Roe wishes to speak to you; will you please hold the line?"

Cut-Offs.—Interruptions to telephone conversations are popularly called "cut-offs." These annoying incidents in telephone usage, while they do not occur frequently, are none the less exasperating. They may be due to the person at either end of the line, to a failure of the telephone circuit, or to a mistake on the part of the operator. The public usually charges all cut-offs to the operator, but actually statistics show that but a small percentage of them are chargeable to her.

When a cut-off occurs and both persons remain at the telephone, each of them will be answered by a different operator, who, being innocent of the cause of the cut-off, answers "number, please," just as though she were answering a call. This is usually the first intimation that you have of the cut-off and naturally you charge the operator with it and demand an immediate restoration of the connection. In those cases where the operator is responsible for the cut-off, she usually knows about it and re-establishes the connection as quickly as she can and without comment to either person involved.

The best thing to do when there is a "cut-off" is to leave the responsibility of re-establishing the connection to the person who made the call, for that person knows what number he called, whereas the person receiving the call is not likely to know from what number the call was made. When a cut-off occurs and the operator says "number, please" (if you made the call), simply say, "I called Main 456 and was cut off." If you were called, hang up your receiver promptly; this will enable the operator answering the signal of the calling party to connect his line with yours and ring your bell. If you keep the receiver off the hook, your line will test "busy" and will be so reported to the person who called you.

Getting Wrong Numbers.—When you call a number and the answer you get indicates that the wrong telephone has been reached, use the expression, "Is this Main 456?" If it is then found that you have the wrong place, say to the person answering, "I beg your pardon; it is a mistake"; then work your hook slowly and when the operator answers, give her the number again. If you are doubtful about the correctness of the number, consult the directory.

When you get a wrong number, it is especially important that you be courteous to the person who answers, for usually he is in no way responsible for the error which may have been yours, the operator's, or because of the apparatus, but certainly not the fault of the person who has been needlessly caused to answer your call.

Answering the Telephone.—There are two doors through which business comes to every establishment—the office door and the "telephone door." In some cases more business comes through the telephone door than through the office door. It is, therefore, as important that the telephone door be guarded by the proper person as it is for the office door to be so guarded. It is essential that the person guarding the telephone door should be courteous; he cannot see the person with whom he is conversing and therefore the softening influence of the smile, the gestures and the facial expressions are lost, leaving only the words and the intonation, which might produce the impression of rudeness, though it were not so intended.

When two persons are face to face, gestures, smiles and bows are the indications of good will and courtesy that assist the spoken word, but in a telephone conversation evidences of good will and temper can only be expressed in the choice of courteous words and the tone in which they are spoken. It is, therefore, most essential that the telephone be answered in a courteous tone and that it be answered promptly.

Avoiding the Use of "Hello."—You would not think of greeting a customer at the front door, particularly one whom you had never seen before, by saying "Hello." What is good usage in face to face conversation is good use in telephone conversations. It is not courteous to answer a telephone with such expressions as "Hello," "Well," "What is it?" and the like.

The Right Way to Answer.—To answer a telephone by giving the number is a little better than to answer "Hello," but is far from the best way to answer. The expression that is most satisfactory to the person calling is the name of the place of business or residence; for example:

"Smith and Companay."
"Dr. Brown's office."
"Mr. Smith's residence."

When you answer a telephone, and someone other than yourself is asked for, it is not good practice to say, "Wait a minute," "Just a minute," or "Do you wish to speak to Mr. Doe?" and the like. If you know that the person called is there, it is preferable to say, "He is here; I'll call him," or if you are doubtful about it, say, "I think he is here; I'll call him." If the person called is not in, the expression should be, "Mr. Doe is not in; this is Mr. Blank." This is a courteous way of giving the person calling an opportunity to leave the message with you, or to make an inquiry.

Called in Error.—On answering the telephone if it is found that you have been called by mistake, it is particularly important to be courteous to the person calling, for nothing can be gained by discourtesy. To just say "the wrong number" and slam up the receiver is as discourteous as to shut the door in the face of a person who has knocked by mistake.

Right and Wrong Methods Compared.—That there are right and wrong methods of using the telephone is apparent from the foregoing. That much time is wasted that might be saved is also apparent. To make this saving more apparent the slow method is here compared with the fast method used by person trained in the best telephone usage.

Slow Method, used by untrained persons—
Person calling removes the telephone receiver.
Operator says, "Number, please?"
Person calling, "Main one twenty-three."
Operator repeats, "Main one-two three?"
Person calling usually says nothing.
Someone answers, "Hello!"
Person calling, "Is that Main one twenty-three?"
Person answers, "Yes."
Person calling, "Is Mr. Doe there?"
Person answering, "Yes, do you want to speak to him?"
Person calling, "Yes."
Person answering, "Wait a minute."
Person wanted answers, "Hello."
Person calling, "Is that Mr. Doe?"
Mr. Doe answers, "Yes."
Person calling, "Well, this is Mr. Blank," and proceeds with the conversation if he is not too exasperated to do so.

Fast Method, used by trained persons—
Person calling removes the telephone receiver.
Operator says, "Number, please?"
Person calling, "Main one-two three."
Operator repeats, "Main one-two three?"
Person calling, "Yes, please."
Someone answers, "Doe and Company."
Person calling, "May I speak to Mr. Doe, please?"
Person answering, "He's here, I'll call him."
Mr. Doe answers, "Mr. Doe."
Person calling, "This is Mr. Blank," and proceeds with the conversation.

If you will count the separate steps in each of these two methods, you will see that the fast method requires but 10 steps, where the slow method requires 16 steps.

When You Call Long Distance.—All that has been said concerning local telephone service is equally applicable to long distance service, with the additional injunction that patience must be exercised if satisfactory results are to be attained.

In making a long distance call the best results will be attained if you proceed in this manner—
Remove the receiver from the hook.
Local operator answers, "Number, please?"
Say to her, "Long Distance."
The long distance operator answers, "Long distance."
Proceed immediately to give your call in this order:
This is Main one-two-three (pause).
Mr. Blank (pause) calling Richard Roe (pause).
At Hemlock four five-six seven (pause).
Memphis, Tennessee.

The long distance operator will repeat the information to you to verify its correctness and will say, "Thank you, we will call you," whereupon you will hang up the receiver and wait until you are called.

The long distance operator will at once proceed to establish connection with the distant city and to reach the person called. Having done so and upon attempting to call you, should she find your line in use she may find it difficult to hold the person on

the line until your line is available. In this event she may have to call the distant person again when she can get you and by this time he may not be available.

To avoid this delay in handling your business and annoyance to the distant person it has been found most satisfactory to keep your line connected with the long distance switchboard long enough for the operator to quickly find out whether she can immediately establish the connection or not. This enables the operator to retain control of your line and to immediately establish the connection when ready to do so. Should it become necessary, however, for your line to be used for some other call the long distance operator will release it upon request.

When a Long Distance Operator Calls You, she is not, as you might suppose, an operator in your city, but at some distant point from which some one has placed a call for you. This operator in the distant city deals directly with you, and having ready for instant connectoin the person calling, she can establish the connection as soon as she reaches you and finds that you are ready to talk.

Should she find that you are not in, or ready to talk, she will leave word for you to call, giving the name of her town or city. In all such cases it is best for a memorandum to be left for the person called, specifying the name of the distant point. If this is not done but word is given to call "Long Distance," difficulty will be experienced by the long distance operator in your city in finding from what point you were called.

Private Branch Exchange Operating.—All that has been said in the foregoing is applicable to the operation of private branch exchanges. The telephone company has a teacher who gives instructions in the best methods of operating private branch exchange switchboards. If you are assigned to this work the teacher will visit you and give you all the time that is necessary to acquaint you with the methods of making connections and the other operating work that you will have to do; but ff you are thoroughly trained in the methods of using the telephone that have been given you in these lessons you should experience little or no difficulty in operating a private branch exchange or in handling any other kind of telephone calls.

Information is the name given to a group of special operators who will give you the number of any telephone connected to the switchboard since the publication of the last telephone directory. If you call a number which has been changed, or you don't know the central office name or party line letter, your operator will connected you with Information so that you may get the number as it should be given to the operator.

The Complaint Bureau is the place in the telephone company to call whenever trouble is experienced with the telephone or the service.

The Operator's Part in Telephone Service.—Referring to the statement that there are three persons to every telephone eall, you are reminded that the telephone operator is human, just as you are, and therefore subject to the same human weaknesses. She may be discourteous, she will make mistakes, and sometimes will not answer the telephone as quickly as you would like; but generally you will find her courteous, accurate and rapid in the handling of her work.

The telephone company is most careful in the selection of its operators and in training them to be uniformly courteous, accurate and prompt in the handling of telephone calls. Being human, telephone operators appreciate kindness and courtesy, but resent unkindness and discourtesy, just as you do. Many persons think that because the operator is not face to face with them that they are at liberty to be as discourteous as they please and to say things that they would not think of saying if they were engaged in a face to face conversation.

Kindness begets kindness, and courtesy begets courtesy; so, if you wish to get the best results in using the telephone, make it a point to be especially kind and courteous to the operator.

Courtesy is today the watchword of business. The discourteous man or woman is soon relegated to the rear and away from contact with the public. Particularly in public service companies is courtesy on the part of employes expected and demanded, for the public will not put up with discourteous treatment from so-called "public servants."

The importance of courtesy is not only stressed in face to face conversation, but it is insisted on in telephone conversations. The way in which employes use the telephone is often taken as an indication of the character of the firm.

If you call a business house and receive a courteous and intelligent answer, you at once assume, and rightly, too, that you are dealing with a progressive establishment that does business along the right lines. On the other hand, if you are met with discourteous or flippant remarks or a tone that shows no interest, the natural assumption is that everything else done by that house is done in the same way and this may influence you to take your trade elsewhere.

Now, most people are naturally courteous, although some persons are more thoughtful and considerate than others. Courtesy, which is but the expression of kindly thoughts, can be developed to a point where it becomes a part of your nature, and just so far as you become proficient in courtesy, just that far do you increase your value to your employer.

Courtesy is dependent upon these virtues:

Patience, which enables you to bear with others and pay attention to their wants.
Regard for the feelings of others.
Equal treatment of all, regardless of race or station
Pleasant manner of speech.
Sympathy with human nature, and
Willingness to serve.

Handling Complaints.—If there is one class of persons that requires more courteous handling than any other, it is that class that makes complaints. Usually when a person calls to make a complaint he is laboring under the belief that he has been neglected or has not been fairly treated. He may be suspicious, impatient and angry, and often is discourteous, but this is no reason why you should be so; on the other hand, under these conditions, it is all the more important that you should be most courteous, so under no provocation, should you become discourteous or become involved in an angry discussion.

Experience has shown that the customer who is angry at what he believes to be neglect or injustice, will be genuinely gratified when you have courteously set him aright.

Thus it is seen that by being kind and considerate, by following the lines of common politeness and with a better knowledge of the "whys" of telephone, usage, we may forestall many of the little ripples that go to make up mistakes that later cause other and more serious interruption to the happy and successful handling of the day's work.

Population 153,000,000 in 1940

Estimates made by the New York Telephone Company indicate that there should be 153,000,000 people in the United States in 1940, with 66 per cent of them living east of the Mississippi river.

New York City's growth as viewed by telephone engineers will be rapid in the next twenty years. In 1940 the telephone people expect to be serving users in a city of more than 11,500,000. "We expect the population of Manhattan borough to be 2,900,000 in 1920, and 3,400,000 in 1940," states F. H. Bethell, vice president of the New York Telephone Company. "We believe the Bronx will more than double in population by 1930. It increased its population from 200,000 to 431,000 between 1900 and 1910, and we expect it to have 875,000 in 1920, about 1,400,000 in 1930, and approximately 2,000,000 in 1940. According to our figures Brooklyn should have a population of 2,500,000 in 1920, and only 40,000 less than 4,000,000 in 1940. For Queens we anticipate a growth of 537,000 in 1920, to 1,024,000 in 1930, and to 1,900,000 in 1940. Richmond should be a borough containing 111,000 in 1920, and 270,000 in 1940."

Shock Absorbers on Telephone Cars

One of the largest single orders for Hassler shock absorbers for Fords was that of the New York Telephone Company which was placed last month and which provides for the equipping of nearly 400 cars.

The telephone company's cars operate as far west as Buffalo, consequently they will cover a large area and over a country both level and hilly.

Business in Porto Rico

Some indications of the business growth of the island of Porto Rico is indicated by figures of earnings of the Porto Rico Telephone Company just made public. The company's gross earnings for the first five months of this year were approximately $125,000, as compared with $93,500 two years ago, an increase of about 34 per cent in the two years. Net earnings of $71,200 for the period are an increase of over 43 per cent.

Service at Camp Greene

The government and the Southern Bell Telephone Company have agreed upon the plan under which telephone service will be handled between Charlotte (N. C.), and Camp Greene and this plan will apply to the national army and national guard camps in the United States.

The service will be handled just like local calls and in the case of Camp Greene there will be a charge of five cents for each message to and from Charlotte and the camp.

The number of the telephone in the camp must be given the operator who answers. Connection will be made with the number called and the operators will not undertake to get a particular party to the telephone. The charge of five cents will be made if the called telephone is answered. In the case of calls for officers or men, it will be necessary to give the operator the name of the organization or regiment and company or the number of the telephone located nearest them, before connection can be made.

It is announced that this plan has been agreed to by the government and the telephone company as the most practicable way in which to handle the government's business satisfactorily and give reasonable service to officers and enlisted men and to the civilian public.

The telephone system at the camp, it is stated, has been installed under government supervision and restriction and is primarily for military purposes. It was realized that with so many officers and men concentrated at one point there would be urgent and emergency occasions when individuals would require a means of communication with Charlotte and other points. To meet this need the government permitted the installation of a limited number of pay stations, located in the Y. M. C. A. buildings throughout the camp.

Telephone officials state that the telephone system at the camp is not a commercial extension of their plant and not constructed with a view to profit making. The company, they say, has met the wishes of the government to the extent of its ability without hope or expectation of a profit. The toll charge for messages is expected to have the effect of discouraging unnecessary and frivilous conversation with a consequent congestion of the lines. The officers and enlisted men will have very few hours when they can use the telephone and the facilities which the government has allowed are considered ample for all business and urgent purposes.

In discussing telephone service for the camp a telephone official said:

"Government business will have the right of way at the camp just as everywhere throughout the Bell system. Lists of telephone numbers in the camp will be published in the newspapers as soon as they are assigned and established by the government.

"In calling for departments, officials or individuals in the camp, it will be necessary to give the telephone number in the camp, for instance Camp Greene 21. Those who have business with the camp should ascertain the number from the parties they have occasion to call. This is essential in order to prevent congestion and delay. Ample information facilities have been arranged and the operators will render whatever assistance they can, although until the various organizations are located and the camp settled in its routine we will need the patient cooperation of the public.

"In the southern states we have installed telephone systems for the government in thirteen camps and cantonments. This has required an enormous quantity of equipment and the services of hundreds of our ablest men. In every case we have kept pace with the contractors and have given this duty preference over everything else. The commercial development of our business has suffered, and in some instances the public has been inconvenienced, but our advertisements have explained the situation and we have found the public considerate and reasonable. In fact, everybody is as anxious as we are to serve the government first."

Phonetic Telegraph Instruction

Clarence H. Weiser, telephone engineer for the Southwestern Bell Telephone Company, in charge of army telegraphers' schools in St. Louis, inaugurated a phonetic method of teaching signal corps telegraphers when the first instruction was given to the class at Eugene Feld school, Taylor avenue and Olive street.

Instead of teaching the novice to send the alphabet, he is required to become proficient in receiving. The student is instructed to recognize the sound itself. By this new system 35 men who were enrolled in the first class learned more than one-third of the alphabet on their first night's instruction.

"This is the method I evolved while in service on the Mexican border," said Mr. Weiser, "and by which I expect to turn out 1,000 men for the Signal Corps in St. Louis during the next four months.

"It is a radical departure from the old style of telegraphy instruction. Every experienced telegraph operator to whom I have demonstrated by method has approved it as a means of rapidly turning out men who can acceptably serve in the army."

Patterson Gives Telephone Outfit

John H. Patterson of Dayton, Ohio, has given to the men of the 149th field artillery stationed at Fort Sheridan, Ill., $1,000 for the purchase of a telephone system to be installed in the camp after the men have gone into active service. The remainder of the sum required, $600, was raised by public subscriptions in Chicago. Col. Henry J. Reilly is commander of the regiment. Mr. Patterson recently paid a visit to the camp.

Mr. Patterson is also arranging to show by lantern slides the insignia of all foreign officers.

"Pennsy" Ry. Equips Another Division

The Little Miami (Ohio) division of the Pennsylvania railroad will use the telephone for dispatching within the next few months. A force of men and linemen have been busy installing telephones, switchboard and stringing a new line of copper from Richmond to Xenia. All the divisions of the Pennsylvania are being cut over the telephone as fast as possible and in time the telephone will take the place of the telegraph for the handling of the company business. The telegraph instruments will be retained for emergency work.

A. T. & T. at Seven Per Cent

In declining to a 7 per cent basis American Telephone and Telegraph common is merely responding to the principle of a higher income, says the New York *Mail*. The foundationless story of a prospective reduction in the dividend may have provoked some selling, but in a broad way the issue has been yielding to other influences. There have been suggestions at various times of sales of stock held as security for foreign loans.

Telephonic Transmission Losses

*of Abridged Impedances, Series Resistances and Capacitances**

BY K. OGAWA AND T. ARAKAWA

IT can not be avoided that a certain amount of transmission loss will occur with any apparatus connected to the telephone circuit. This is true even with apparatus inserted for the purpose of raising the transmission efficiency. For instance, in pupinizing the telephone line, the loss due to the accompanying increased resistance is inevitable; to magnify the received current, the insertion of some apparatus such as repeating coils with a telephone repeater might be required which brings some loss of transmission.

The circuit must be designed as economically as possible. As a general rule, economy and good service are inconsistent, and this rule is not out of truth in the case of telephonic transmission. Viewed from the point of minimizing the transmission loss, the telephone circuit while transmitting the speech should be made up only of those parts which are directly necessary for the purpose of speaking—that is, the telephone at both ends and the line wires connecting them are all which are required. But to get quick operation of the service and to make efficient use of telephone lines, apparatus is required which is not only unnecessary but also injurious for the transmission of speech. Protecting devices for lighting, etc., must also be included in the circuit. This apparatus impairs the transmission to some degree, though it is constructed so as to make the losses as small as possible. For the compensation of these losses, it becomes necessary to use thicker wires, which require more primary and annual costs than the thinner ones.

Thus in designing and constructing apparatus the telephone engineer must always bear in mind that the apparatus is required to attain its proper object and at the same time to make the transmission losses due to it as small as possible. As a natural result, he is induced to measure and calculate the transmission losses of the apparatus; for the quantitative knowledge of the transmission loss gives much assistance in designing telephone systems.

In the practical calculations now in use, the transmission losses of all apparatus are assumed constant, independent of the lines to which they are connected and of the points at which they are inserted. The transmission equivalents of several lines are merely calculated by the attenuation lengths. These are true approximately, but in strict sense they are not. The transmission losses of some apparatus differ by the line to which they are connected and by the point at which they are inserted. The transmission equivalents of several lines calculated by attenuation lengths are correct only if the terminal reflections should not be present. The terminal reflections are, however, always present and differ with the kind of lines unless some special terminal apparatus is used for each kind of lines. In the present practice the same terminal apparatus is used on almost any lines except loaded ones, and accordingly the terminal reflection is not the same for different kinds of lines.

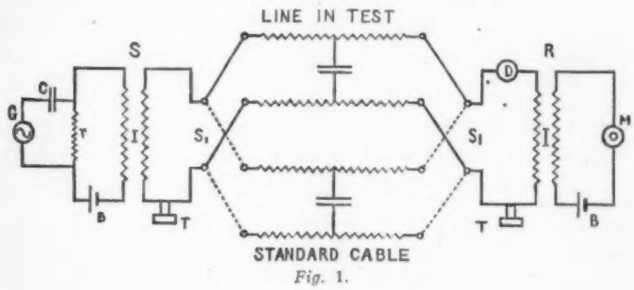


Fig. 1.

These facts are all well known to telephone engineers. Then why do they adopt the present practice of calculations? Chiefly because the calculation in strict sense is very troublesome; and the error brought forth by the use of the present method is not very much, and it is, in most cases, under the limit of human sensation of tone if a single piece of apparatus is taken. But small errors sometimes make up large ones if many of them are taken together. Therefore, if there is any convenient method of calculation which is more exact than the present practice, though not absolutely correct, it must be appreciated.

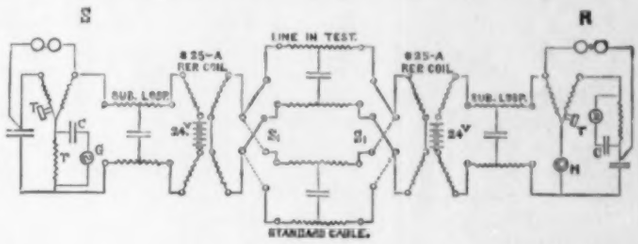


Fig. 2.

With this idea, several researches were made in our laboratory with respect to telephonic transmission losses. The present report is the succession of those investigations and deals with the transmission loss of several apparatus inserted in series or shunt at any point of the line.

Fig. 1 is the diagram of requisite connections in the case of a magneto system, where S and R are the sending and receiving sets respectively. G is Duddell's high frequency generator, r a resistance replacing the transmitter at the sending set, S_1, four switches which are capable of cutting over from the line in test to standard cable or vice versa, T receivers, D Duddell's thermo-galvonometer, I induction coils, M microphone, B batteries, C condenser.

A high frequency alternating E.M.F. is applied by the generator G to the line in test or to standard cable, the switches being used to cut over from the one to the other, and the length of standard cable is so adjusted as to make the deflections of the galvanometer D equal at both positions of the switches. But as the smallest section of standard cable used for experiments is 0.5 mile, we cannot, in general, obtain exactly equal deflection. In that case, the equivalents are calculated by proportion from two lengths of standard cable which give the nearest deflections on both sides of the deflection for the line in test. Also as we had not in hand the standard cable of 88 ohm resistance per loop mile and 0.054 microfarad wire-to-wire capacity per mile, the artificial standard

*Report No. 19 of the Second Series of Electro-Technical Laboratory, Tokyo, Japan.

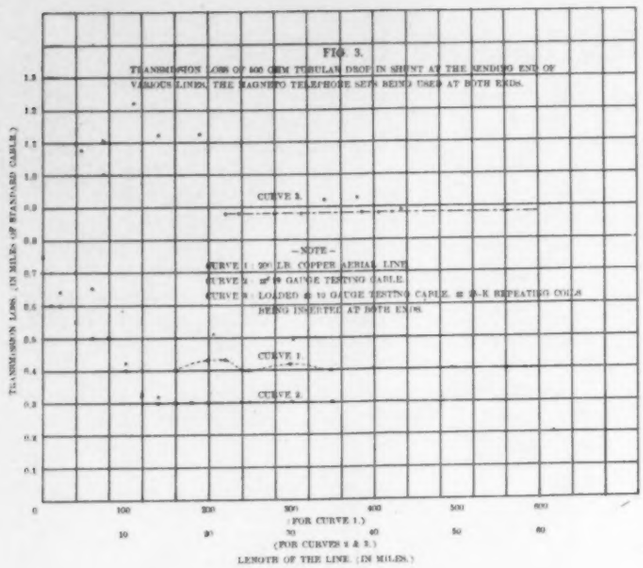


FIG. 3.
TRANSMISSION LOSS OF 600 OHM TUBULAR DROP IN SHUNT AT THE SENDING END OF VARIOUS LINES, THE MAGNETO TELEPHONE SETS BEING USED AT BOTH ENDS.
CURVE 3.
—NOTE—
CURVE 1: 200 LB. COPPER AERIAL LINE.
CURVE 2: 19 GAUGE TESTING CABLE.
CURVE 3: LOADED 19 GAUGE TESTING CABLE, 88-K REPEATING COILS BEING INSERTED AT BOTH ENDS.
CURVE 1.
CURVE 2.
TRANSMISSION LOSS (IN MILES OF STANDARD CABLE.)
(FOR CURVE 1.)
(FOR CURVES 2 & 3.)
LENGTH OF THE LINE (IN MILES.)

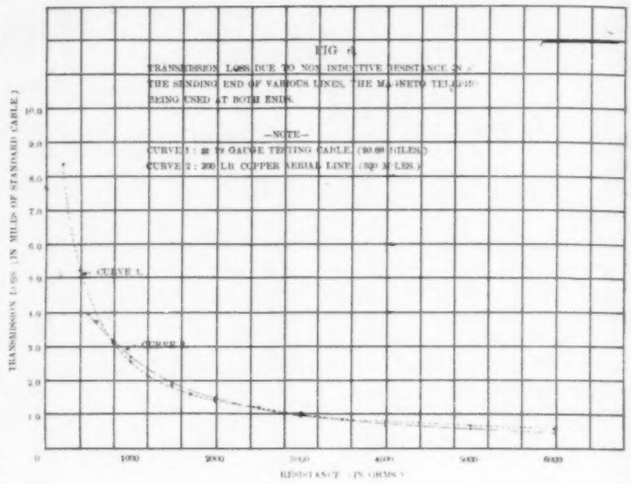


FIG. 6.
TRANSMISSION LOSS DUE TO NON-INDUCTIVE RESISTANCE IN THE SENDING END OF VARIOUS LINES, THE MAGNETO TELEPHONE BEING USED AT BOTH ENDS.
—NOTE—
CURVE 1: 19 GAUGE TESTING CABLE. (30.68 MILES.)
CURVE 2: 200 LB. COPPER AERIAL LINE. (300 MILES.)
CURVE 1.
CURVE 2.
TRANSMISSION LOSS (IN MILES OF STANDARD CABLE.)
RESISTANCE (IN OHMS.)

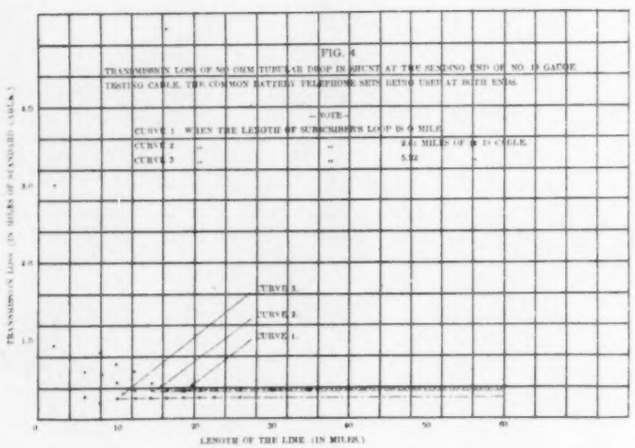


FIG. 4.
TRANSMISSION LOSS OF 600 OHM TUBULAR DROP IN SHUNT AT THE SENDING END OF NO. 19 GAUGE TESTING CABLE, THE COMMON BATTERY TELEPHONE SETS BEING USED AT BOTH ENDS.
—NOTE—
CURVE 1: WHEN THE LENGTH OF SUBSCRIBER'S LOOP IS 0 MILE.
CURVE 2: " " 2.61 MILES OF 19 CABLE.
CURVE 3: " " 5.22 "
CURVE 3.
CURVE 2.
CURVE 1.
LENGTH OF THE LINE (IN MILES.)

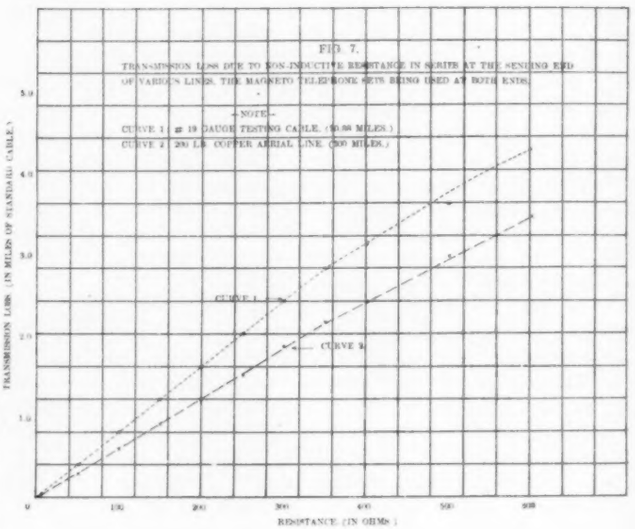


FIG. 7.
TRANSMISSION LOSS DUE TO NON-INDUCTIVE RESISTANCE IN SERIES AT THE SENDING END OF VARIOUS LINES, THE MAGNETO TELEPHONE SETS BEING USED AT BOTH ENDS.
—NOTE—
CURVE 1: 19 GAUGE TESTING CABLE. (30.68 MILES.)
CURVE 2: 200 LB. COPPER AERIAL LINE. (300 MILES.)
CURVE 1.
CURVE 2.
TRANSMISSION LOSS (IN MILES OF STANDARD CABLE.)
RESISTANCE (IN OHMS.)

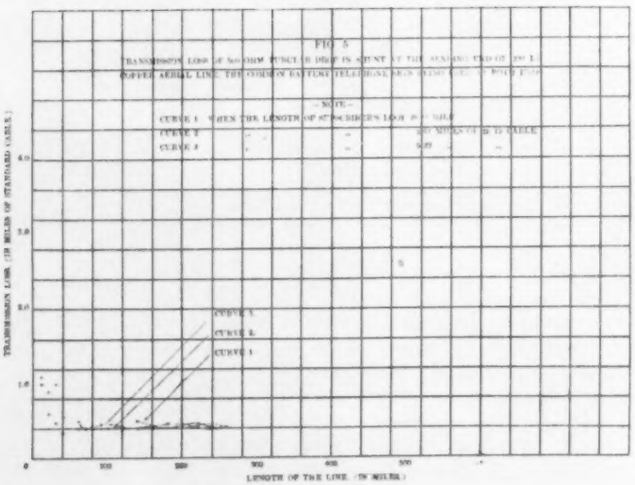


FIG. 5.
TRANSMISSION LOSS OF 600 OHM TUBULAR DROP IN SHUNT AT THE SENDING END OF NO. 19 COPPER AERIAL LINE, THE COMMON BATTERY TELEPHONE SETS BEING USED AT BOTH ENDS.
—NOTE—
CURVE 1: WHEN THE LENGTH OF SUBSCRIBER'S LOOP IS 0 MILE.
CURVE 2: " " 261 MILES OF 19 CABLE.
CURVE 3: " " 5.22 "
CURVE 3.
CURVE 2.
CURVE 1.
TRANSMISSION LOSS (IN MILES OF STANDARD CABLE.)
LENGTH OF THE LINE (IN MILES.)

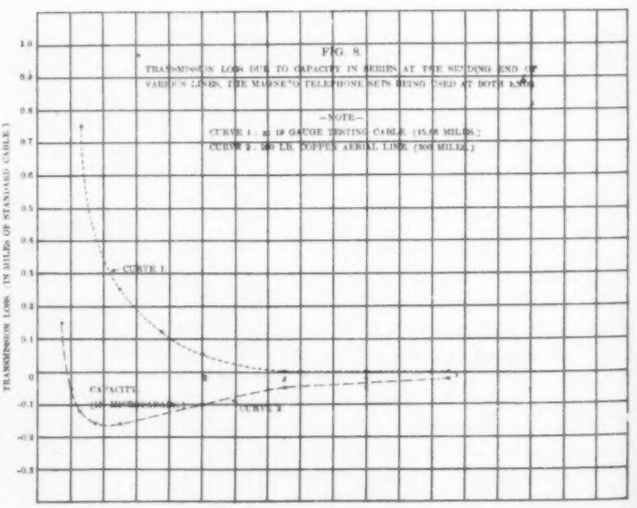


FIG. 8.
TRANSMISSION LOSS DUE TO CAPACITY IN SERIES AT THE SENDING END OF VARIOUS LINES, THE MAGNETO TELEPHONE SETS BEING USED AT BOTH ENDS.
—NOTE—
CURVE 1: 19 GAUGE TESTING CABLE. (15.68 MILES.)
CURVE 2: 200 LB. COPPER AERIAL LINE. (300 MILES.)
CURVE 1.
CAPACITY
CURVE 2.
TRANSMISSION LOSS (IN MILES OF STANDARD CABLE.)

cable of 88 ohm and 0.06 microfarad was used throughout the experiments.

In measurements, the frequency of the generator was kept at 800 cycles per second, and the current at the sending end of the line was made a few milliamperes, by adjusting the speed, the field excitation, and the series resistance of the generator.

In this connection, in order to get the transmission loss due to the apparatus inserted in the circuit, it is only necessary to get the equivalent length of standard cable, when the apparatus is inserted in the circuit and when it is removed from the circuit. Then the difference of these two equivalents will obviously give the transmission loss due to that apparatus.

In the case of a common battery system, the method of measurement is similar to that of the magneto system. Fig. 2 shows the requisite connections for that case. The difference from the magneto system is that the common battery subscriber's telephone sets, No. 25-A repeating coils and 24 volt batteries are used at both sending and receiving ends.

The kinds of line wires used for the experiments are as follows:

400 lb. copper aerial line,
200 lb. copper aerial line,
50 lb. copper aerial line,
No. 19 gauge testing cable,
No. 22 gauge testing cable,
Loaded No. 19 gauge cable.

II—TRANSMISSION LOSS DUE TO BRIDGED, OR SERIES IMPEDANCE AT THE SENDING END

When apparatus such as relays, drops, etc., are inserted in a telephone circuit in order to make for the efficient use of the circuit, it is accompanied always by a certain amount of transmission loss. After a few experiments, it is easily seen that the transmission loss of an apparatus is not constant but largely depends upon the kind of line wire of the circuit, its length, the telephone sets at both ends and also the point of insertion of the apparatus. In this chapter let us consider experimentally the transmission loss of an apparatus when it is inserted at the sending end of the circuit.

The first experiments were made to determine how the transmission loss due to bridged or series impedance at the sending end varies with the length of the line. The results of the experiments are shown in Figs. 3, 4 and 5.

From these results, it is seen that the loss is not always constant, but depends upon the kind of line wires, and the telephone sets at the sending and receiving ends. It is also different for the different length of line, but if the line is sufficiently long, it approaches to a certain limiting value and remains practically constant so long as the kinds of line wire and the telephone sets at both ends are the same.

This is obvious if we consider that the final sending end impedance of a line varies with its length and the impedance of the receiving set; but when the line becomes sufficiently long, it gradually approaches to a certain limiting value called the initial sending end impedance and becomes practically independent of the magnitude of impedance of the receiving set. The minimum length of a line in which the initial and final sending end impedances can be taken practically equal, is different for different kinds of line, depending upon its attenuation constant.

The second experiments were to determine how the loss varies with the various kinds of line wires when they are sufficiently long. The results are shown in Table I.

TABLE I—TRANSMISSION LOSS (IN MILES OF STANDARD CABLE) OF APPARATUS AT THE SENDING END OF VARIOUS TELEPHONE LINES, THE MAGNETO TELEPHONE SETS BEING USED AT BOTH ENDS

Apparatus—Lines.	*400 lb. copper aerial line.*	*200 lb. copper aerial line.*	*50 lb. copper aerial line.*	*No. 19 gauge testing cable.*	*No. 22 gauge special cable*	*Loaded No. 19 gauge cable.*
500ω drop in shunt....	0.45	0.40	0.50	0.30	0.40	0.52
3,000ω non-inductive resistance in shunt	0.83	1.00	1.30	1.00	1.30	1.00
150ω non-inductive resistance in series	0.97	1.04	0.70	1.34	1.10	0.59
1 m. f. capacity in series	—0.25	—0.15	0.08	0.27	0.35	—0.11

These results show that the loss it tolerably different according as the apparatus is connected to cables, aerial lines and loaded cables; but it is not so much different for the different kinds of cables or aerial lines of which electrical constants are alike. It is on this that we assume, in rough calculations, the transmission loss of apparatus to be constant for any kind of non-loaded cables or aerial lines, but we consider separately the transmission loss of apparatus connected to loaded lines.

Next let us see how the losses due to resistance and capacitance inserted in series or shunt at the sending end of the line vary with their magnitudes. The results of experiments are shown in Figs. 6, 7 and 8. We see that the transmission loss of non-inductive resistance in shunt decreases with the increase of resistance, the rate being nearly inversely proportional to the latter; thus, if we take the resistance as abscissae and the loss as ordinates, the curve becomes nearly rectangular hyperbola. On the other hand, if the resistance is in series the loss is directly proportional to the resistance, the curve being almost a straight line. In the case of a series condenser, the experiment shows the interesting fact that there is a gain of transmission if the condenser is connected in series to 200 lb. copper aerial line at the sending end. On the other hand, if it is connected at the sending end of No. 19 gauge cable, we have a transmission loss which is inversely proportional to the capacity the accompanying curve being nearly a rectangular hyperbola.

The mathematical interpretation will be found in Chapter 4.

III—TRANSMISSION LOSS DUE TO BRIDGED OR SERIES IMPEDANCE (INCLUDING CAPACITANCE) AT ANY POINT OF THE LINE.

In the previous chapter, we saw that the transmission loss due to bridged or series impedance at the sending end of the line is not always constant but depends upon the kind of line wires and the telephone sets at both ends. The loss is also different for different points of insertion. Many experiments were conducted on this subject of which results are shown in Figs. 9 to 20.

In these figures we see the following interesting facts:

1. If the distance from the sending end to the point of insertion of any apparatus be taken as abscissae and the corresponding loss as ordinates, the curve is always symmetrical with respect to the middle point of the line, having a maximum or minimum at the middle point, so far as the present experiments are concerned where the telephone sets at both ends are the same.

2. The transmission loss of an apparatus is not the same if the total length of the line is different, though the kind of line wires and telephone sets at both ends and the distance from the sending end to the point of insertion are all the same.

3. In No. 19 gauge testing cable, the curve has a minimum or maximum point at the middle point of the

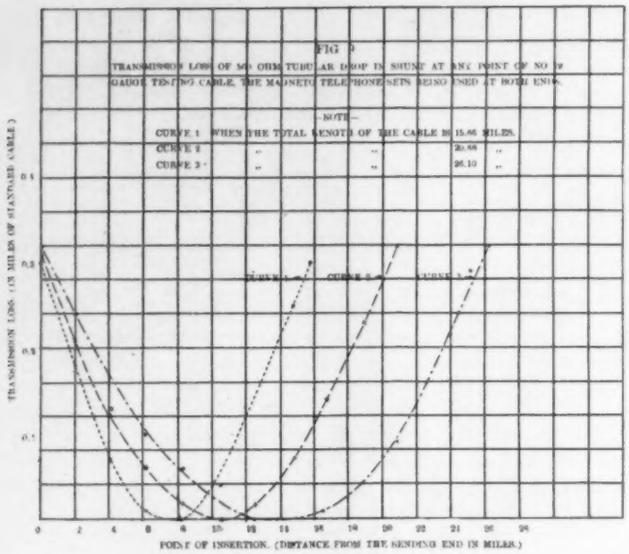


FIG 9
TRANSMISSION LOSS OF 500 OHM TUBULAR DROP IN SHUNT AT ANY POINT OF NO 19 GAUGE TESTING CABLE, THE MAGNETO TELEPHONE SETS BEING USED AT BOTH ENDS.
—NOTE—
CURVE 1 WHEN THE TOTAL LENGTH OF THE CABLE IS 15.86 MILES.
CURVE 2 " " " 20.48 "
CURVE 3 " " " 26.10 "
CURVE 1
CURVE 2
CURVE 3
TRANSMISSION LOSS (IN MILES OF STANDARD CABLE)
POINT OF INSERTION. (DISTANCE FROM THE SENDING END IN MILES.)

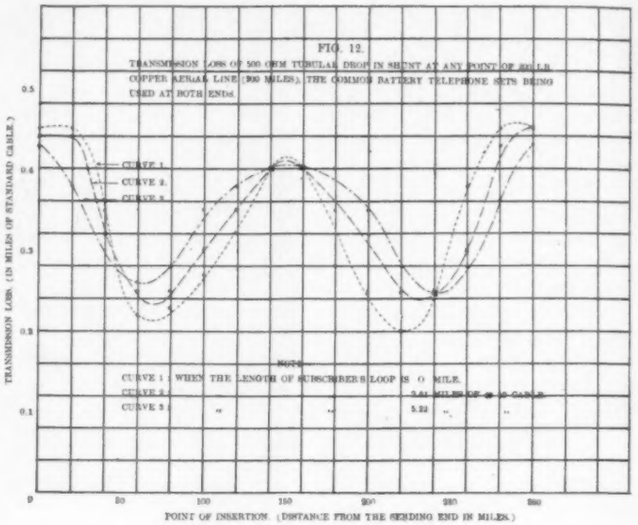


FIG. 12.
TRANSMISSION LOSS OF 500 OHM TUBULAR DROP IN SHUNT AT ANY POINT OF 200 LB. COPPER AERIAL LINE (200 MILES), THE COMMON BATTERY TELEPHONE SETS BEING USED AT BOTH ENDS.
—NOTE—
CURVE 1 : WHEN THE LENGTH OF SUBSCRIBER'S LOOP IS 0 MILE.
CURVE 2 " " " 2.61 MILES OF 19 CABLE.
CURVE 3 " " " 5.22 " "
CURVE 1.
CURVE 2.
CURVE 3.
TRANSMISSION LOSS (IN MILES OF STANDARD CABLE)
POINT OF INSERTION. (DISTANCE FROM THE SENDING END IN MILES.)

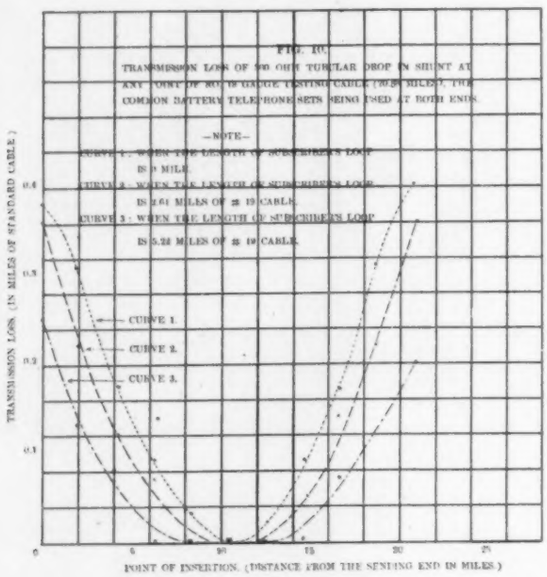


FIG. 10.
TRANSMISSION LOSS OF 500 OHM TUBULAR DROP IN SHUNT AT ANY POINT OF NO 19 GAUGE TESTING CABLE (200 MILES), THE COMMON BATTERY TELEPHONE SETS BEING USED AT BOTH ENDS.
—NOTE—
CURVE 1 : WHEN THE LENGTH OF SUBSCRIBER'S LOOP IS 0 MILE.
CURVE 2 : WHEN THE LENGTH OF SUBSCRIBER'S LOOP IS 2.61 MILES OF 19 CABLE.
CURVE 3 : WHEN THE LENGTH OF SUBSCRIBER'S LOOP IS 5.22 MILES OF 19 CABLE.
CURVE 1.
CURVE 2.
CURVE 3.
TRANSMISSION LOSS (IN MILES OF STANDARD CABLE)
POINT OF INSERTION. (DISTANCE FROM THE SENDING END IN MILES.)

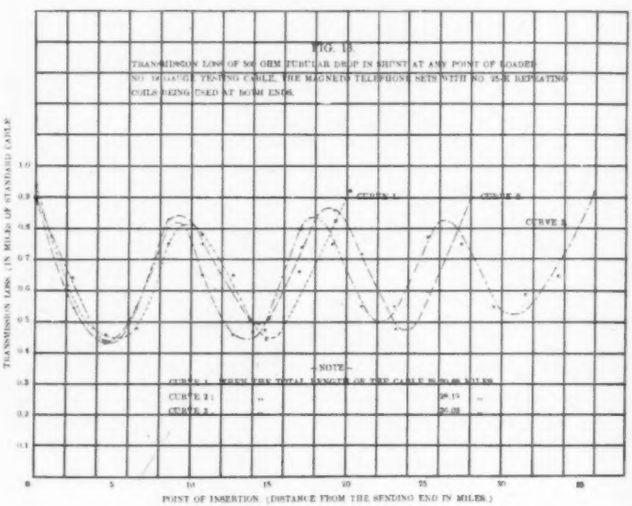


FIG. 13.
TRANSMISSION LOSS OF 500 OHM TUBULAR DROP IN SHUNT AT ANY POINT OF LOADED NO 19 GAUGE TESTING CABLE, THE MAGNETO TELEPHONE SETS WITH NO. 25-K REPEATING COILS BEING USED AT BOTH ENDS.
—NOTE—
CURVE 1 : WHEN THE TOTAL LENGTH OF THE CABLE IS 20.48 MILES
CURVE 2 : " " " 26.10 "
CURVE 3 : " " " 31.72 "
CURVE 1.
CURVE 2.
CURVE 3.
TRANSMISSION LOSS (IN MILES OF STANDARD CABLE)
POINT OF INSERTION. (DISTANCE FROM THE SENDING END IN MILES.)

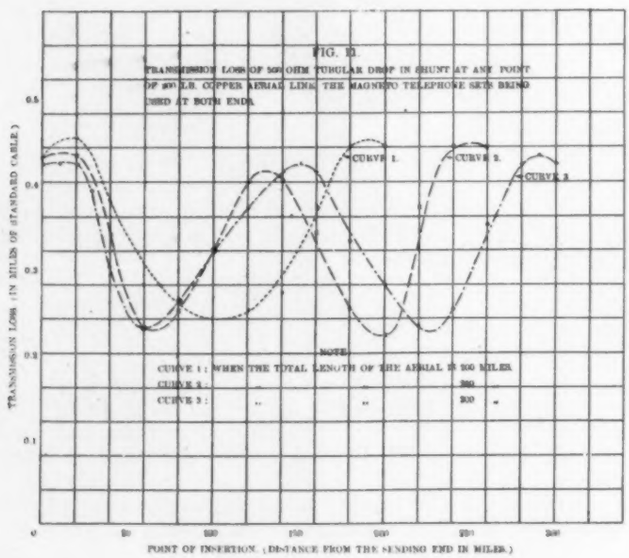


FIG. 11.
TRANSMISSION LOSS OF 500 OHM TUBULAR DROP IN SHUNT AT ANY POINT OF 200 LB. COPPER AERIAL LINE, THE MAGNETO TELEPHONE SETS BEING USED AT BOTH ENDS.
—NOTE—
CURVE 1 : WHEN THE TOTAL LENGTH OF THE AERIAL IS 100 MILES.
CURVE 2 : " " " 200 "
CURVE 3 : " " " 300 "
CURVE 1.
CURVE 2.
CURVE 3.
TRANSMISSION LOSS (IN MILES OF STANDARD CABLE)
POINT OF INSERTION. (DISTANCE FROM THE SENDING END IN MILES.)

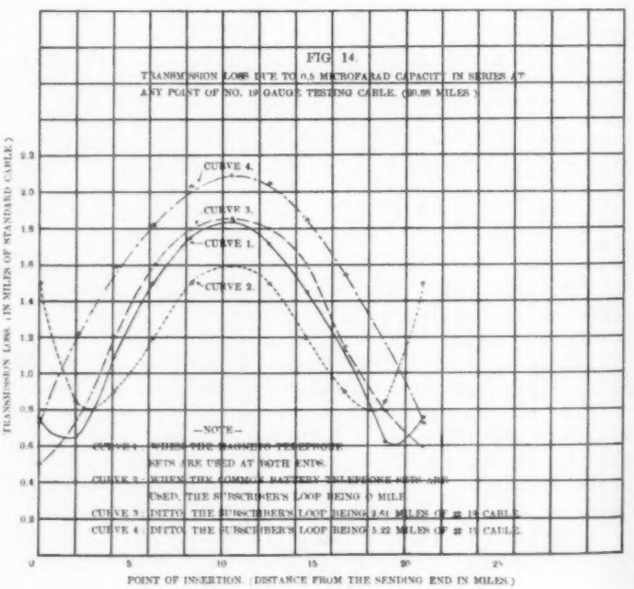


FIG. 14.
TRANSMISSION LOSS DUE TO 0.5 MICROFARAD CAPACITY IN SERIES AT ANY POINT OF NO. 19 GAUGE TESTING CABLE. (30.98 MILES.)
CURVE 4.
CURVE 3.
CURVE 1.
CURVE 2.
—NOTE—
CURVE 1 : WHEN THE MAGNETO TELEPHONE SETS ARE USED AT BOTH ENDS.
CURVE 2 : WHEN THE COMMON BATTERY TELEPHONE SETS ARE USED, THE SUBSCRIBER'S LOOP BEING 0 MILE.
CURVE 3 : DITTO, THE SUBSCRIBER'S LOOP BEING 2.61 MILES OF 19 CABLE.
CURVE 4 : DITTO, THE SUBSCRIBER'S LOOP BEING 5.22 MILES OF 19 CABLE.
TRANSMISSION LOSS (IN MILES OF STANDARD CABLE)
POINT OF INSERTION. (DISTANCE FROM THE SENDING END IN MILES.)

line, and gradually rises or falls toward both ends. In 200 lb. copper aerial line, and loaded No. 19 gauge testing cable, the curve is of wave form and its amplitude increases gradually toward both ends.

In some particular cases, a simple empirical formula can be conveniently established for the transmission loss of an apparatus inserted at any point of the line. For example, if 500 ohm tubular drop, 600 ohm self-restoring drop, No. 16-A relay, etc., are bridged in No. 19 gauge cable, the loss is expressed without much deviation, within the range of the present experiments, by the formula

$$L_c = A_c - B_c \sin\frac{\pi x}{l},$$

where L_c=transmission loss of the apparatus bridged in the circuit at a point distant x from the sending end,
l=length of the line,
A_c, B_c=numerical constants which are determined experimentally.

When they are inserted in 200 lb. copper aerial line, the loss is expressed by the formula

$$L_a = A_a + B_a \cos\frac{2\pi n x}{l},$$

where L_a, A_a, B_a denote the same as before and n is the integral part of the ratio

$$\frac{\textit{Length of the line}}{\textit{One half of wave length of the line}}.$$

The following table shows the numerical value of the constants A_c, B_c, A_a, B_a obtained experimentally.

	A_c	B_c	A_a	B_a
500 ohm tubular drop	.30	.30	.31	.09
1,000 ohm tubular drop	.28	.28	.28	.07
600 ohm self-restoring drop	.25	.25	.24	.07
‡16-A relay	.08	.08	.09	.02
‡89-B relay	.28	.28	.22	.07
1,000 ohm subscriber's magneto bell	.13	.13	.13	.05

IV—THEORY OF THE PHENOMENA

It is a well-known fact that if a constant sinusoidal E.M.F. be applied to one end of the telephone line, the potential difference and the current at any point of the line are expressed in the vector equation as follows:

$$V_x = \frac{EZ_0\{Z_0 \sinh a(l-x) + Z_r \cosh a(l-x)\}}{(Z_0^2 + Z_rZ_s)\sinh al + Z_0(Z_r+Z_s)\cosh al}, \quad \cdots\cdots\cdots (1)$$

$$I_x = \frac{E\{Z_r \sinh a(l-x) + Z_0 \cosh a(l-x)\}}{(Z_0^2 + Z_rZ_s)\sinh al + Z_0(Z_r+Z_s)\cosh al}, \quad \cdots\cdots\cdots (2)$$

where
V_x=potential difference at a point of the line distant x from the sending end,
I_x=current at a point of the line distant x from the sending end,
E=impressed alternating E. M. F. at the sending end,
Z_0=initial sending end impedance of the line,
Z_s=impedance of the sending set,
Z_r=impedance of the receiving set,
a=vector attenuation constant of the line,
l=length of the line.

If we put $x=o$ in the above equations, we get the expression of the potential difference and the current at the sending end of the line; that is, if V_0 and I_0 are the potential difference and the current at the sending end, we have

$$V_0 = \frac{EZ_0\{Z_0 \sinh al + Z_r \cosh al\}}{(Z_0^2 + Z_rZ_s)\sinh al + Z_0(Z_r+Z_s)\cosh al}, \quad \cdots\cdots\cdots (3)$$

$$I_0 = \frac{E\{Z_r \sinh al + Z_0 \cosh al\}}{(Z_0^2 + Z_rZ_s)\sinh al + Z_0(Z_r+Z_s)\cosh al}. \quad \cdots\cdots\cdots (4)$$

Again, if we put $x=l$, we get the potential difference and the current at the receiving end; that is,

$$V_r = \frac{EZ_0Z_r}{(Z_0^2 + Z_rZ_s)\sinh al + Z_0(Z_r+Z_s)\cosh al}, \quad \cdots\cdots\cdots (5)$$

$$I_r = \frac{EZ_0}{(Z_0^2 + Z_rZ_s)\sinh al + Z_0(Z_r+Z_s)\cosh al}. \quad \cdots\cdots\cdots (6)$$

Now let us consider the transmission loss when a concentrated impedance is inserted in shunt or series to the line.

(1) Case in which a concentrated impedance is inserted in shunt to the line.

Let
E=impressed alternating E.M.F at the sending end,
Z_0=initial sending end impedance of the line,
Z_s=impedance of the sending set,
Z_r—impedance of the receiving set,
Z_x=shunted impedance at the point distant x from the sending end,
$a=\alpha+j\beta$=Vector attenuation constant of the line,
l=length of the line.

Then, from the formulae (3) and (4), the current flowing toward the receiving end from a point at which the shunted impedance is inserted, is

$$I_x = \frac{V\{Z_r \sinh a(l-x) + Z_1 \cosh a(l-x)\}}{Z_1\{Z_1 \sinh a(l-x) + Z_r \cosh a(l-x)\}},$$

where V is the potential difference at that point.

Again, since the current flowing through the shunted impedance is

$$I_x = \frac{V}{Z_x},$$

the current arrived at that point from the sending end, is

$$I_1 = I_x + I_3 = V\left[\frac{1}{Z_x} + \frac{Z_r \sinh a(l-x) + Z_1 \cosh a(l-x)}{Z_1\{Z_1 \sinh a(l-x) + Z_r \cosh a(l-x)\}}\right].$$

Hence, from the formula (5), the potential difference at a point at which the shunted impedance is inserted, is

$$V = \frac{EZ_1Z}{(Z_1^2 + Z_sZ)\sinh ax + Z_1(Z+Z_s)\cosh ax},$$

where

$$Z = \frac{1}{\frac{1}{Z_x} + \frac{Z_r \sinh a(l-x) + Z_1 \cosh a(l-x)}{Z_1\{Z_1 \sinh a(l-x) + Z_r \cosh a(l-x)\}}}$$

The current at the receiving end is, from the formula (6),

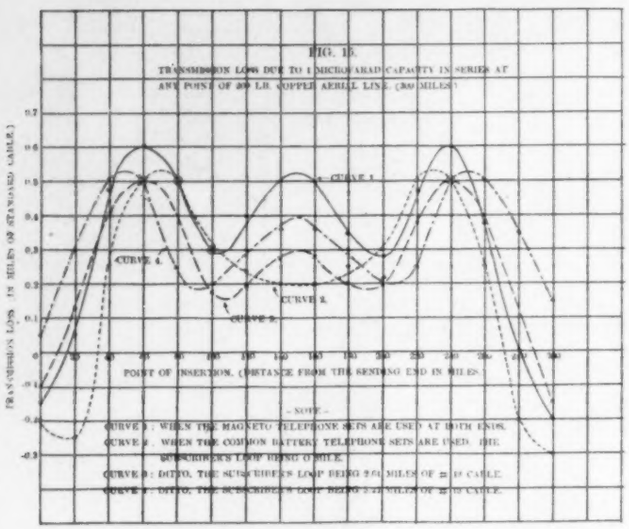
$$I_r = \frac{V}{Z_1 \sinh a(l-x) + Z_r \cosh a(l-x)}.$$

Substituting the above value of V in this formula, and operating a few mathematical reductions upon it, we have

$$I_r = \frac{EZ_1Z_x}{[(Z_1^3 + Z_1Z_rZ_x + Z_1Z_sZ_x)\sinh a(l-x)\sinh ax + (Z_1^2Z_r + Z_1^2Z_x + Z_rZ_sZ_x)\cosh a(l-x)\sinh ax + (Z_1^2Z_x + Z_1^2Z_s + Z_rZ_sZ_x)\sinh a(l-x)\cosh ax + (Z_1Z_rZ_x + Z_1Z_1Z_s + Z_1Z_sZ_x)\cosh a(l-x)\cosh ax]}.$$

FIG. 15.

TRANSMISSION LOSS DUE TO 1 MICROFARAD CAPACITY IN SERIES AT ANY POINT OF 400 LB. COPPER AERIAL LINE. (200 MILES)

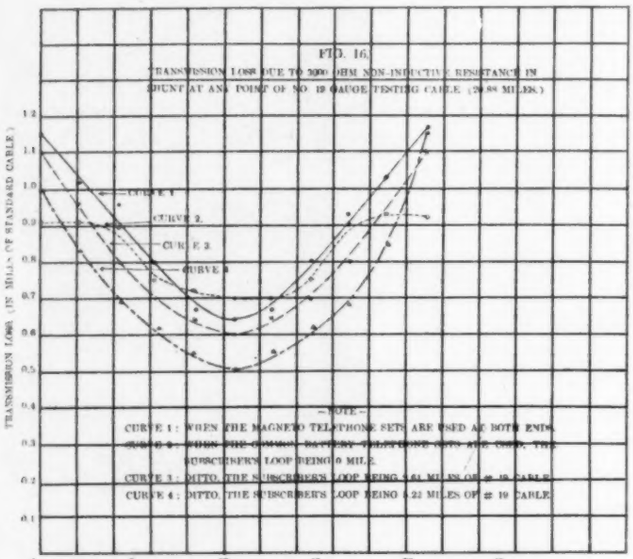

TRANSMISSION LOSS (IN MILES OF STANDARD CABLE)
CURVE 1
CURVE 4
CURVE 2
CURVE 3
POINT OF INSERTION. (DISTANCE FROM THE SENDING END IN MILES.)

—NOTE—

CURVE 1: WHEN THE MAGNETO TELEPHONE SETS ARE USED AT BOTH ENDS.
CURVE 2: WHEN THE COMMON BATTERY TELEPHONE SETS ARE USED, THE SUBSCRIBER'S LOOP BEING O MILE.
CURVE 3: DITTO, THE SUBSCRIBER'S LOOP BEING 2.61 MILES OF # 19 CABLE.
CURVE 4: DITTO, THE SUBSCRIBER'S LOOP BEING 5.22 MILES OF # 19 CABLE.

FIG. 16.

TRANSMISSION LOSS DUE TO 3000 OHM NON-INDUCTIVE RESISTANCE IN SHUNT AT ANY POINT OF NO. 19 GAUGE TESTING CABLE. (20.88 MILES.)

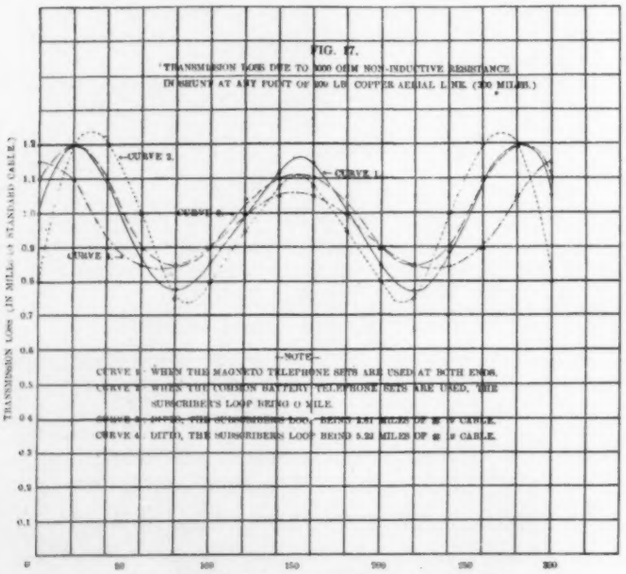

TRANSMISSION LOSS (IN MILES OF STANDARD CABLE)
CURVE 1
CURVE 2
CURVE 3
CURVE 4
POINT OF INSERTION. (DISTANCE FROM THE SENDING END IN MILES.)

—NOTE—

CURVE 1: WHEN THE MAGNETO TELEPHONE SETS ARE USED AT BOTH ENDS.
CURVE 2: WHEN THE COMMON BATTERY TELEPHONE SETS ARE USED, THE SUBSCRIBER'S LOOP BEING O MILE.
CURVE 3: DITTO, THE SUBSCRIBER'S LOOP BEING 2.61 MILES OF # 19 CABLE.
CURVE 4: DITTO, THE SUBSCRIBER'S LOOP BEING 5.22 MILES OF # 19 CABLE.

FIG. 17.

TRANSMISSION LOSS DUE TO 1000 OHM NON-INDUCTIVE RESISTANCE IN SHUNT AT ANY POINT OF 400 LB. COPPER AERIAL LINE. (200 MILES.)


TRANSMISSION LOSS (IN MILES OF STANDARD CABLE)
CURVE 2
CURVE 1
CURVE 4
CURVE 3
POINT OF INSERTION. (DISTANCE FROM THE SENDING END IN MILES.)

—NOTE—

CURVE 1: WHEN THE MAGNETO TELEPHONE SETS ARE USED AT BOTH ENDS.
CURVE 2: WHEN THE COMMON BATTERY TELEPHONE SETS ARE USED, THE SUBSCRIBER'S LOOP BEING O MILE.
CURVE 3: DITTO, THE SUBSCRIBER'S LOOP BEING 2.61 MILES OF # 19 CABLE.
CURVE 4: DITTO, THE SUBSCRIBER'S LOOP BEING 5.22 MILES OF # 19 CABLE.

FIG. 18

TRANSMISSION LOSS DUE TO 150 OHM NON-INDUCTIVE RESISTANCE IN SERIES AT ANY POINT OF NO. 19 GAUGE TESTING CABLE. (20.88 MILES.)

—NOTE—

CURVE 1: WHEN THE MAGNETO TELEPHONE SETS ARE USED AT BOTH ENDS.
CURVE 2: WHEN THE COMMON BATTERY TELEPHONE SETS ARE USED, THE SUBSCRIBER'S LOOP BEING O MILE.
CURVE 3: DITTO, THE SUBSCRIBER'S LOOP BEING 2.61 MILES OF # 19 CABLE.
CURVE 4: DITTO, THE SUBSCRIBER'S LOOP BEING 5.22 MILES OF # 19 CABLE.

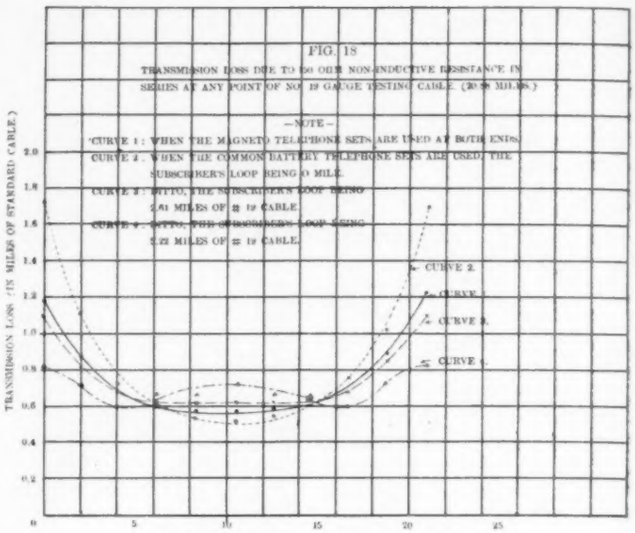
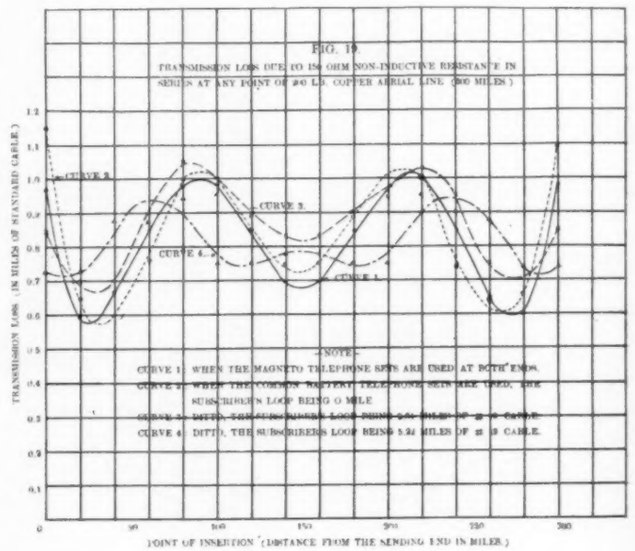

TRANSMISSION LOSS (IN MILES OF STANDARD CABLE)
CURVE 2
CURVE 1
CURVE 3
CURVE 4
POINT OF INSERTION. (DISTANCE FROM THE SENDING END IN MILES.)

FIG. 19.

TRANSMISSION LOSS DUE TO 150 OHM NON-INDUCTIVE RESISTANCE IN SERIES AT ANY POINT OF #40 L.B. COPPER AERIAL LINE. (200 MILES.)

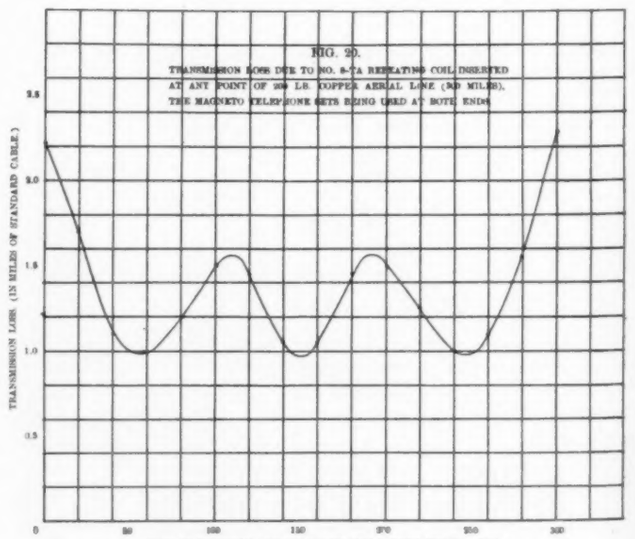

TRANSMISSION LOSS (IN MILES OF STANDARD CABLE)
CURVE 2
CURVE 3
CURVE 4
CURVE 1
POINT OF INSERTION. (DISTANCE FROM THE SENDING END IN MILES.)

—NOTE—

CURVE 1: WHEN THE MAGNETO TELEPHONE SETS ARE USED AT BOTH ENDS.
CURVE 2: WHEN THE COMMON BATTERY TELEPHONE SETS ARE USED, THE SUBSCRIBER'S LOOP BEING O MILE.
CURVE 3: DITTO, THE SUBSCRIBER'S LOOP BEING 2.61 MILES OF # 19 CABLE.
CURVE 4: DITTO, THE SUBSCRIBER'S LOOP BEING 5.22 MILES OF # 19 CABLE.

FIG. 20.

TRANSMISSION LOSS DUE TO NO. 8-TA REPEATING COIL INSERTED AT ANY POINT OF 200 LB. COPPER AERIAL LINE (100 MILES), THE MAGNETO TELEPHONE SETS BEING USED AT BOTH ENDS.



Now, since

$$2\sinh a(l-x)\sinh ax=\cosh al-\cosh a(l-2x),$$
$$2\cosh a(l-x)\sinh ax=\sinh al-\sinh a(l-2x),$$
$$2\sinh a(l-x)\cosh ax=\sinh al+\sinh a(l-2x),$$
$$2\cosh a(l-x)\cosh ax=\cosh al+\cosh a(l-2x),$$

we may write

$$I_r=\frac{EZ_1}{\left[\left\{Z_1(Z_r+Z_s)\cosh al+(Z_1^2+Z_rZ_s)\sinh al\right\}+\frac{1}{2Z_x}\left\{A\cosh al+B\sinh al+C\cosh a(l-2x)+D\sinh a(l-2x)\right\}\right]}. \quad \cdots (7)$$

where

$$A=Z_1(Z_1^2+Z_rZ_s),$$
$$B=Z_1^2(Z_r+Z_s),$$
$$C=Z_1(Z_rZ_s-Z_1^2),$$
$$D=Z_1^2(Z_s-Z_r),$$

If $Z_s=Z_r$, which is always approximately the case in the ordinary telephone transmission, we have

$$A=Z_1(Z_1^2+Z_r^2), \qquad B=2Z_1^2Z_r,$$
$$C=Z_1(Z_r^2-Z_1^2), \qquad D=0,$$

and the formula (7) becomes

$$I_r=\frac{EZ_1}{\left[\left\{2Z_1Z_r\cosh al+(Z_1^2+Z_r^2)\sinh al\right\}+\frac{1}{2Z_x}\left\{A\cosh al+B\sinh al+C\cosh a(l-2x)\right\}\right]}. \quad \cdots (8)$$

From this formula, we see that the transmission loss due to the shunted impedance is equal at the points equal distant from the middle point of the line; or if we take the distance of the shunted impedance from the sending end as abscissae, and the corresponding transmission loss as ordinates, the curve thus obtained will be symmetrical with respect to the middle of the line. (See Chapter III.)

If the length of the line be so long that e^{-al} can be neglected compared with e^{al}, we may put

$$\cosh al=\sinh al=\frac{1}{2}e^{al}$$

and, accordingly, we have

$$I_r=\frac{EZ_1}{(Z_1+Z_r)^2\frac{e^{al}}{2}+\frac{1}{2Z_x}\left\{(A+B)\frac{e^{al}}{2}+C\cosh a(l-2x)\right\}},$$

where

$$A+B=Z_1(Z_1+Z_r)^2, \quad C=Z_1(Z_r^2-Z_1^2),$$

or

$$I_r=\frac{2EZ_1e^{-al}}{(Z_1+Z_r)^2\left\{1+\frac{Z_1}{2Z_x}+\frac{Z_1(Z_r-Z_1)e^{-al}}{Z_x(Z_r+Z_1)}\cosh a(l-2x)\right\}}. \quad \cdots (9)$$

It is well known that the transmission equivalent of any telephone circuit is expressed by an equivalent length of standard cable; thus, if we assume

Z_0=initial sending end impedance of standard cable,

$a_0=\alpha_0+j\beta_0$=vector attenuation constant of standard cable,

l_0=equivalent length of standard cable,

we must have

$$\text{Absolute value of}\ \frac{2EZ_0}{(Z_0+Z_r)^2}e^{-a_0l_0}=\text{Absolute value of}\ \frac{2EZ_1e^{-al}}{(Z_1+Z_r)^2\left\{1+\frac{Z_r}{2Z_1}+\frac{Z_x(Z_1-Z_r)}{Z_1(Z_r+Z_x)}e^{-al}\cosh a(l-2x)\right\}}$$

provided that the line is sufficiently long. Taking the logarithms of both sides of this equation, we have

$$\log\left|\frac{Z_0}{(Z_0+Z_r)^2}\right|+\log\left|e^{-a_0l_0}\right|=\log\left|\frac{Z_1}{(Z_1+Z_r)^2}\right|+\log\left|e^{-al}\right|-\log\left|1+\frac{Z_1}{2Z_x}+\frac{Z_1(Z_r-Z_1)e^{-al}}{Z_x(Z_r+Z_1)}\cosh a(l-2x)\right|$$

where the brackets (||) denotes the absolute value of the complex quantity under the bracket.

Now since

$$\log\left|e^{-al}\right|=-al,$$

the above formula is transformed into

$$a_0l_0=al+\log\left|\frac{Z_0(Z_1+Z_r)^2}{Z_1(Z_0+Z_r)^2}\right|+\log\left|1+\frac{Z_1}{2Z_x}+\frac{Z_1(Z_r-Z_1)e^{-al}}{Z_x(Z_r+Z_1)}\cosh a(l-2x)\right|.$$

If Z_x be so large that the absolute value of

$$\frac{Z_1}{2Z_x}+\frac{Z_1(Z_r-Z_1)e^{-al}}{Z_x(Z_r+Z_1)}\cosh a(l-2x)$$

is small enough compared with unity, we have, neglecting the second and higher powers of it,

$$\log\left|1+\frac{Z_1}{2Z_x}+\frac{Z_1(Z_r-Z_1)e^{-al}}{Z_x(Z_r+Z_1)}\cosh a(l-2x)\right|$$
$$=\log\sqrt{1+2\times\text{Real part of}\left\{\frac{Z_1}{2Z_x}+\frac{Z_1(Z_r-Z_1)e^{-al}}{Z_x(Z_r+Z_1)}\cosh a(l-2x)\right\}}$$
$$=\text{Real part of}\left\{\frac{Z_1}{2Z_x}+\frac{Z_1(Z_r-Z_1)e^{-al}}{Z_x(Z_r+Z_1)}\cosh a(l-2x)\right\}.$$

Hence we have finally

$$a_0l_0=al+\log\left|\frac{Z_0(Z_1+Z_r)^2}{Z_1(Z_0+Z_r)^2}\right|+\text{Real part of}\left\{\frac{Z_1}{2Z_x}+\frac{Z_1(Z_r-Z_1)e^{-al}}{Z_x(Z_r+Z_1)}\cosh a(l-2x)\right\} \quad \cdots (10)$$

provided that the line is sufficiently long and the shunted impedance is sufficiently large, which is of the most frequent occurrence in practice. The first term of this formula is evidently the transmission loss due to the line itself, which is the expression widely used in telephone engineering. The second term is the reflection equivalent. The third term is the transmission loss due to the shunted impedance at any point of the line. It is seen that the transmission loss due to the shunted impedance consists of two parts, namely, the constant loss,

which the first part of the third term represents, and the variable loss, which is dependent on the point of insertion of the shunted impedance and is represented by the second part of the third term.

Let us now consider more fully the third term.

If we put

$$\frac{Z_1(Z_r-Z_1)e^{-al}}{Z_s(Z_r+Z_1)} = R\ (\cos\theta + j\sin\theta),$$

where R is the absolute value and θ the phase angle, then the second part of the third term may be transformed as follows:

$$\text{Real part of}\frac{Z_1(Z_r-Z_1)e^{-al}}{Z_s(Z_r+Z_1)}\cosh a(l-2x)$$

$$= \text{Real part of } R(\cos\theta + j\sin\theta)\left\{\begin{matrix}\cosh a(l-2x)\cos\beta(l-2x)\\ +j\sinh a(l-2x)\sin\beta(l-2x)\end{matrix}\right\}$$

$$= R\left\{\cos\theta\cosh a(l-2x)\cos\beta(l-2x) - \sin\theta\sinh a(l-2x)\sin\beta(l-2x)\right\}$$

$$= R\sqrt{\left\{\cosh^2 a(l-2x) - \sin^2\theta\right\}}\cos\left\{\beta(l-2x)+\varphi\right\},$$

where $\varphi = \tan^{-1}\left\{\tan\theta\tanh a(l-2x)\right\}$.

Hence the transmission loss due to the shunted impedance is expressed by the formula

$$\frac{1}{a_0}\left[\left(\text{Real part of}\frac{Z_1}{2Z_s}\right) + R\sqrt{\left\{\cosh^2 a(l-2x) - \sin^2\theta\right\}}\cos\left\{\beta(l-2x)+\varphi\right\}\right], \quad \cdots(11)$$

$$\text{Real part of}\left\{\frac{Z_1}{2Z_s} + \frac{Z_1(Z_r-Z_1)}{2Z_s(Z_r+Z_1)}\right\}$$

or $$\text{Real part of}\frac{Z_1Z_r}{Z_s(Z_1+Z_r)} \quad \cdots\cdots\cdots\cdots(12)$$

When the shunted impedance is inserted at the sending or receiving end, the third term of the formula (10) reduces with reasonable abbreviation to

where $$\varphi = \tan^{-1}\left\{\tan\theta\tanh a(l-2x)\right\}.$$

which would more simply be obtained from the formula (8).

It is seen that the transmission loss due to the shunted impedance at the sending or receiving end depends upon the initial sending end impedance of the line to which it is inserted, and is independent of the length of the line, if the line be sufficiently long. This agrees well with the results of our experiments in Chapter II in which it was seen that the transmission loss due to the shunted impedance at the sending end is tolerably different for cables, aerial lines, and loaded cables, but independent of the length of the line if the line is sufficiently long.

Next let us consider the general case in which the shunted impedance is inserted at an intermediate point of the line. The formula (11) shows that the transmission loss of an apparatus depends upon not only its impedance but also the kind of line wires, its length, the telephone sets at both ends and the point of insertion; and if we take the distance of the point of insertion from the sending end as abscissae and the corresponding loss as ordinates, the curve becomes a wave form, the middle point of the line being maximum or minimum point of the wave. Of course, the amplitude of the wave becomes larger as the point of insertion of the shunted impedance approaches to either end, since the value of $\cosh a\ (l-2x)$ is minimum when $x = \frac{l}{2}$.

Hence the largest loss due to the shunted impedance is found by observing the amplitude of the wave near the both ends. In the usual case of telephonic transmission, it is sufficient to consider the small range of al, say up to 4. Then it is easily seen that if a is small and β is large enough, the curve becomes a wave form having two or more wave crests even in this limited range of al. This is the reason why the curve has many wave crests in the previous experiments of aerial copper lines in which a is sufficiently small and β is many times of a; and why the curve becomes a single loop in the experiments of non-loaded cable in which a is much larger compared with that of the formed and β is nearly equal to a.

(2.) Case in which a concentrated impedance is inserted in series to the line.

Let us use the same notation as in Case (1) except Z_x which, instead of a shunted impedance, denotes a series impedance inserted at any point of the line distant x from the sending end. Then, proceeding as in the previous case, it will be easily seen that the current flowing through the series impedance Z_x, is expressed in the vector equation as follows:

$$\frac{\left\{(x-l)\alpha\cos\ {}^1Z + (x-l)\alpha\sin\ {}^2Z\right\}}{\left\{(x-l)\alpha\cos\ {}^2Z + (x-l)\alpha\sin\ {}^1Z\right\}{}^1Z} + {}^xZ = I$$

where V is the potential difference at the point of the sending end side of the series impedance Z_x. Hence by the general formula (5), we have

$$V = \frac{EZ_1Z}{(Z_1^2+ZZ_s)\sinh ax + Z_1(Z+Z_s)\cosh ax},$$

where

$$Z = Z_x + \frac{Z_1\{Z_1\sinh a(l-x) + Z_r\cosh a(l-x)\}}{Z_r\sinh a(l-x) + Z_1\cosh a(l-x)}.$$

Accordingly, by the general formula (6), the current flowing through the telephone at the receiving end is

$$I_r = \frac{VZ_1}{(Z_1^2+Z_rZ_x)\sinh a(l-x) + Z_1(Z_r+Z_x)\cosh a(l-x)}.$$

Substituting the values of V and Z in this formula and performing a few mathematical reductions upon it, we have finally

$$I_r = \frac{EZ_1^2}{\left[(Z_1^2Z_r + Z_sZ_xZ_r + Z_sZ_1^2)\sinh a(l-x)\sinh ax\right.}$$
$$+(Z_1^3 + Z_sZ_1Z_x + Z_sZ_rZ_1)\cosh a(l-x)\sinh ax$$
$$+(Z_1Z_sZ_r + Z_1Z_xZ_r + Z_1^3)\sinh a(l-x)\cosh ax$$
$$\left.+(Z_1^2Z_s + Z_1^2Z_x + Z_1^2Z_r)\cosh a(l-x)\cosh ax\right].$$

Now since

$$2\sinh a(l-x)\sinh ax = \cosh al - \cosh a(l-2x),$$
$$2\cosh a(l-x)\sinh ax = \sinh al - \sinh a(l-2x),$$
$$2\sinh a(l-x)\cosh ax = \sinh al + \sinh a(l-2x),$$
$$2\cosh a(l-x)\cosh ax = \cosh al + \cosh a(l-2x),$$

we may write

$$I_r=\frac{EZ_1}{\left[\left\{Z_1(Z_r+Z_s)\cosh al+(Z_1^2+Z_rZ_s)\sinh al\right\}+\frac{1}{2Z_1}\left\{A\cosh al+B\sinh al+C\cosh a(l-2x)+D\sinh a(l-2x)\right\}\right]} \quad \cdots(13)$$

where

$$A=Z_s(Z_1^2+Z_rZ_s),$$
$$B=Z_sZ_1(Z_r+Z_s),$$
$$C=Z_s(Z_1^2-Z_rZ_s),$$
$$D=Z_sZ_1(Z_r-Z_s).$$

If $Z_r=Z_s$ which is, as stated before, approximately

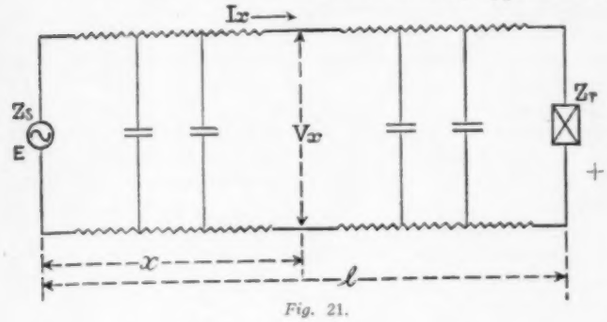


Fig. 21.

the case in the ordinary telephone transmission, we have

$$A=Z_s(Z_1^2+Z_r^2),\quad B=2Z_sZ_1Z_r,\quad C=Z_s(Z_1^2-Z_r^2),\quad D=0,$$

and I_r becomes

$$I_r=\frac{EZ_1}{\left[\left\{2Z_1Z_r\cosh al+(Z_1^2+Z_r^2)\sinh al\right\}+\frac{1}{2Z_1}\left\{A\cosh al+B\sinh al+C\cosh a(l-2x)\right\}\right]} \quad \cdots(14)$$

which shows that the value of the transmission loss due

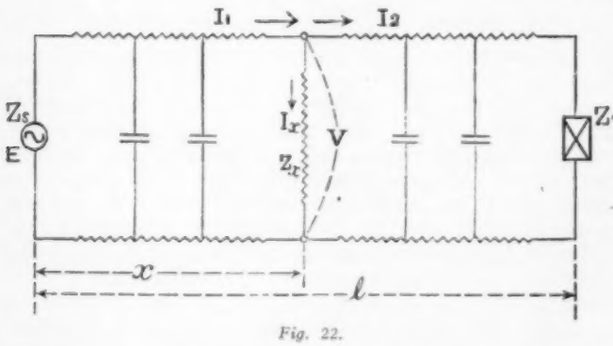


Fig. 22.

to a concentrated series impedance is equal at the points equal distant from the middle point of the line.

If the line be so long that we can neglect e^{-al} compared with e^{al}, the formula (14) reduces to

$$I_r=\frac{2EZ_1e^{-al}}{(Z_1+Z_r)^2\left\{1+\frac{Z_s}{2Z_1}+\frac{Z_s(Z_1-Z_r)}{Z_1(Z_1+Z_r)}e^{-al}\cosh a(l-2x)\right\}} \quad \cdots(15)$$

Now let us find the expression of the transmission equivalent of the line under consideration. Let, as before,

Z_0=initial sending end impedance of standard cable,

$a_0=a_0+j\beta_0$=vector attenuation constant of standard cable,

l = Equivalent length of standard cable.

Then we must have

$$\text{Absolute value of}\frac{2EZ_0e^{-a_0l_0}}{(Z_0+Z_r)^2}$$
$$=\text{Absolute value of}\frac{2EZ_1e^{-al}}{(Z_1+Z_r)^2\left\{1+\frac{Z_1}{2Z_s}+\frac{Z_1(Z_r-Z_1)e^{-al}}{Z_s(Z_r+Z_1)}\cosh(l-2x)\right\}},$$

provided that the line is sufficiently long. Taking the logarithms of both sides and proceeding in a similar manner as before, we have

$$a_0l_0=al+\log\left|\frac{Z_0(Z_1+Z_r)^2}{Z_1(Z_0+Z_r)^2}\right|$$
$$+\text{Real part of}\left\{\frac{Z_r}{2Z_1}+\frac{Z_s(Z_1-Z_r)e^{-al}}{Z_1(Z_1+Z_r)}\cosh a(l-2x)\right\} \quad \cdots\cdots(16)$$

This is of a similar form as the previous case, and similar conclusions can be given. The transmission loss due to the series impedance consists of two parts; the one is independent and the other dependent on the point of insertion of the series impedance.

Now put

$$\frac{Z_s(Z_1-Z_r)e^{-al}}{Z_1(Z_1+Z_r)}=R(\cos\theta+j\sin\theta),$$

where R is the absolute value and θ the phase angle; then,

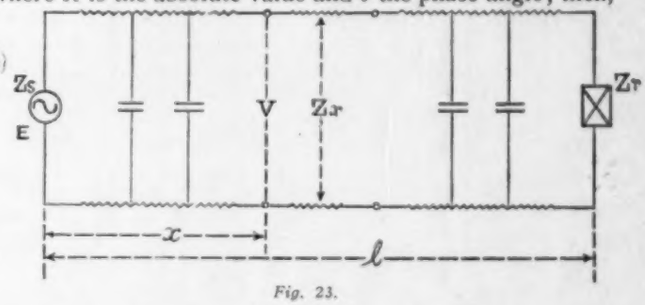


Fig. 23.

proceeding as before, the transmission loss due to the series impedance is expressed by the formula

$$\frac{1}{a_0}\left[\left(\text{Real part of}\frac{Z_s}{2Z_1}\right)+R\sqrt{\cosh^2 a(l-2x)-\sin^2\theta}\cos\left\{\beta(l-2x)+\varphi\right\}\right] \quad \cdots\cdots(17)$$

where

$$\varphi=\tan^{-1}\left\{\tan\theta\tanh a(l-2x)\right\}$$

provided that the line is sufficiently long, and the series impedance is sufficiently small.

When the series impedance is inserted at the sending or receiving end, the third term of the formula (16) reduces, with reasonable abbreviation, to

$$\text{Real part of}\frac{Z_s}{Z_1+Z_r}, \quad \cdots\cdots(18)$$

a result which would more easily be obtained from the formula (14).

In the above discussions the case in which the line is not so long that e^{-al} can not be neglected compared with e^{al}, and the case in which the impedance at the receiving end is not equal to that of the sending end, have been omitted; for the mathematical treatment is too complex to be utilized for practical calculations. Even the formula above obtained are tolerably troublesome for practical calculations, though they clearly interpret all the characteristic properties of the transmission loss due to concentrated impedance in series or shunt to the line. The authors' intention in the above discussions is to show theoretically that the transmission loss due to concentrated impedance in series or shunt to the line is not constant but depends upon the kind of line wires, its length, telephone sets at both ends and the point of insertion. For practical calculations, the authors recommend a simple method which will be described in the next chapter.

(To be concluded.)

Operators Deny Union Affiliation

Telephone girls in the employ of the Home Telephone Company, of Spokane, Wash., in a communication directed to the *Chronicle*, brand as "silly, ridiculous and unworthy of consideration" statements of D. P. Reid of the Electrical Workers' Union that personal violence was used against the telephone girls to prevent them from organizing a union.

They also deny the statements that the girls have organized a union.

The communication to the *Chronicle*, signed by the operators, follows:

"Will you be good enough to grant us sufficient space to correct the articles appearing in your issues of August 30 and 31. The article of the 30th, carrying the heading, 'Phone Girls Organize,' states that the operators of the Home Telephone Company were organized at a meeting held in the company's building on Wall street, and were affiliated with the International Brotherhood of Electrical Workers.

"We, the undersigned, who were in attendance at the meeting, wish to correct this statement. The meeting was called by the operators for the purpose of hearing Miss Rose Barry, a special organizer of the International Brotherhood of Electrical Workers, who has for several days, with the assistance of several local members, attempted to organize the operators into a union.

"An unsuccessful effort was made by Miss Barry throughout the meeting, to secure signers to the proposed organization. Not one signature was secured.

"After considerable discussion, followed by many questions put to Miss Barry, which she could not answer satisfactorily, and some of which she persistently refused to attempt to answer, the meeting was adjourned without an organization being formed.

"The sentiment was practically unanimous that a union would be detrimental to the best interests of the operating employes, and we wish to brand as false the statement that a union was formed at this meeting.

"Referring also to the article appearing in your issue of August 31, headed, 'Says Phone Firm Used Violence': In this article charges are made by D. P. Reid that personal violence against the telephone operators was used by the Home Telephone Company to prevent them from organizing a union and that operators have been forcibly jerked from their chairs at the switchboard and sent to the telephone office because they would not sign an agreement to keep out of the union.

"Any efforts made by the operators to prevent the formation of a union were entirely voluntary on our part. Such statements as were made by Mr. Reid are so ridiculous that we hardly deem it worth while to offer a correction. We, however, fearing that the public might believe his statements to be true, take this opportunity of branding them as silly, ridiculous, unworthy of consideration and gross misstatements."

The statement was signed by sixty-two operators, with seventy-one more concurring.

Finding Operators

The two telephone companies in Louisville, Ky., have been advertising for girls for several weeks, and it was stated by the manager of one of them that this condition obtained all over the United States.

"We are not suffering yet, but if conditions do not improve I do not know what will happen," Philip S. Pogue, general manager of the Louisville Home Telephone Company, said. "We generally have two or three dozen girls in our training school, but at present we have not so large a number. They are hard to get right now. The cantonment, especially, has served to reduce their number."

It was explained that the girls were not working at the cantonment, but that thousands of men were and the girls had found it possible to secure positions which ordinarily would have been filled by men. Hundreds of men in Louisville who heretofore earned $12 and $15 a week, or a little more, have found employment with the contractors for construction of Camp Taylor, for salaries 100 per cent larger. Naturally, their exodus from the city decreased the number of men for clerical work, and when Louisville employers requisitioned girls to fill their places and the number available for work in the telephone exchanges was lessened. Girls in some of the exchanges receive from $5 to $10 a week, and the clerical work many have been doing recently pays considerably more.

Louisville telephone companies are not the only sufferers, Mr. Pogue said, for anyone who reads the newspapers can see that telephone companies everywhere are advertising every day for additional female help.

Motorcycle Wireless Generator

A new form of motorcycle wireless telephone outfit, the invention in part of Captain Frank E. Evans, of the corps now in charge of New York recruiting, is being tried out by the United States Marine corps. The generator in Captain Evans' design forms an integral part of the motorcycle and when it is desired to signal an aeroplane or field wireless telephone station, all that is necessary is to lower a frame which raises the rear wheel free of the ground and then apply the power, through a worm drive, to the generator.

Captain Evans' outfit, including the aerial pole, which is of fine steel and pointed like a fishing rod, does not weigh more than 12 pounds complete and can handle messages from 50 to 100 miles. Tests have been made and show that skilled men at this work can have the entire apparatus connected up and ready to receive messages in from one and a half to two and a half minutes.

The aerial itself is not the least remarkable part of the outfit. It is made of fine wire, an alloy of copper and steel. When extended it looks like an old-fashioned coiled soft spring extended to a distance of 12 feet. When released it springs back into coil, taking up very little room and weighing not more than a pound and a half.

European Telephone Development

Translations from the Foreign Press and Communications from European Engineers

BY FRED W. SCHOLZ

WHEN equipping a new telephone exchange, the principal requirement is the proper designing and estimating of equipment in such a way that it not only meets all the needs of the present time, but also gives room for expansion for years to come. This space of time, which is figured for most exchanges at fifteen years, is long enough to figure with approximate accuracy what the proper and expected growth will be, without going into too great expenses that may not be covered by future development of the telephone system. Of course, it is self-evident that the building space of the exchange must be large enough to care for all the apparatus needed within the fifteen-year period. If a new building is contemplated, the plans should be made to meet the needs at the end of the fifteen-year period. It may even be necessary to buy or take an option on neighboring real estate so as not to be cramped in space or be crowded out by unforeseen circumstances.

The first exchange equipment usually includes all the apparatus needed to give satisfactory telephone service for the next three or five years. As the expansion that will be needed at the end of that time takes on the average one year's time, it will be necessary to begin plans and construction for expansion after two or four years, as the case may be. We will now go into greater details and keep in the main to the usual c. b. telephone system, found in most cities.

General Viewpoints: First of all, figures must be obtained for the expected number of subscribers' lines that will be connected with the exchange at the end of fifteen years, also concerning the equipment and traffic in the exchange as it then exists and the needed changes. Where there is a plan of development covering the future form of the telephone system and the state of the individual exchanges in that system, for cities having a final number of connections of 10,000 subscribers per exchange or more, this plan is easily consulted and gives all the needed information. If such a plan is not on hand, and that will be the case in numerous small city exchanges, the figures of the preceding years can be taken as a basis of computation. To this end diagrams should be constructed and kept up-to-date to show the number of subscribers' connections. These diagrams should show the total number of connections as well as the connections separated into the measured-rate service and the flat rate service connections. The development of these two types for the last ten years will give sufficiently accurate figure for the next five-year period. Likewise a study is made whether the population has grown; whether any of the surrounding hamlets or suburbs have been incorporated into the city; whether there is likelihood of the same thing occurring within the next five years. Another question to be investigated is the economic and commercial aspect of the city. Is the factory development or the commercial expansion of the city such that it will grow beyond its present population within the next five years? Neighboring communities should also be investigated, to see whether the service with these communities might not increase within the period studied so as to make an added exchange or greater equipment to meet this necessity. The estimates should be made fairly liberal, as the appreciation of telephone service is growing with time and more people are realizing that the telephone is as much of a necessity and vital commodity as any other public utility like light or heat. Where the ratio between population and telephone connections per capita has remained behind the ratio of a neighboring community, it is safe to figure on a greater development in the near future to keep pace with the more advanced community.

A. Local Service: The following points have to be determined in this connection: 1. Number of the subscribers' connections in total, connected at the time the study is made. This again is subdivided into: (a) measured-rate service subscribers, (b) flat-rate service subscribers, (c) telephone pay stations. 2. Number of calls during any day of the week, figured for each hour of the day separately, for the total day, and for the classes 1*a*, 1*b*, 1*c* separately. A comparison between the traffic by hours will show what hour shows the greatest and heaviest traffic conditions. This hour we might abbreviate HT-hour (heaviest traffic hour). Then the ratio between daily traffic and traffic in the HT-hour must be found separately for the measured-rate service (MR-service) and for the flat-rate service (FR-service) and this will be expressed something like 8.2:1 for the MR- or the FR-service. From the figures found under 1 and 2 we get the number of calls per day and per type of service coming into the exchange.

If the exchange has been making continued studies over various types of service, the estimating is very simple, as past records need merely be studied without going into any laborious and expensive special rate study. This suggests the necessity for systematic and continued records of service and traffic conditions by the exchange, such as is made in most large city exchanges, but not, unfortunately, by smaller telephone exchanges. If the diagrams and records show that certain seasons of the year are subject to heavy fluctuations of service, those months that give this kind of variation must be taken as a basis for estimates of future development. However, this does not mean that temporary high traffic peaks, as will be found in the weeks just before Christmas, are to be taken as a basis for computation. Should the statistical summaries not seem entirely true to actual facts, it is advisable to make a new study of traffic conditions. If such a study is made at a time when telephone service is weak, as would be the case in summer, an additional factor of 15 or 20 per cent must be added to reach a basis of computation.

The HT-hour usually falls into the forenoon, ordinarily into the hours from 9 to 12 a. m. Many exchanges find this hour to lie exactly between 9 and 10, others between 10 and 11, or 11 and 12 o'clock. The traffic curve usually reaches a second peak of heavy traffic in the afternoon, though usually not as high as in the forenoon. The ratio between daily service and service during the HT-hour varies within the values 10 and 7, lying usually near 8 or 9. Frequently the values for the MR- and the FR-service differ, smaller for the former and greater for the latter.

The number of calls per day, going out from a

MR-service line, varies within very wide limits, depending on the character of the city, whether primarily a commercial, industrial or residential center. There are other factors that come into consideration, as for example, where a city is the seat of numerous official and administrative departments. Finally the total number of connections has its great influence. In small exchanges and small cities each MR-service connection makes about twelve to sixteen calls; with increasing number of subscribers this number increases to eighteen and twenty-two. This figure may increase to 24, depending on the nature of the business engaged in, the time of the year, height of season in a certain trade, etc. Higher figures are not often found in smaller exchanges. If a business finds that it makes as high as thirty calls or more a day from an outgoing trunk wire, it will find it necessary to add more trunks to take care of the outgoing calls, as the chances are that incoming calls will find the wires busy most of the time and the business would be interfered with by this fact. In large telephone systems with over 20,000 connections the number of calls from the average measured rate service line drops down to seventeen.

With FR-service lines the average calls per day may drop as low as two and four calls. Here also there are fluctuations with the months and the seasons. In the FR-service the number of calls usually does not pass beyind a certain maximum limit.

B. Interoffice Trunks: (*IT-Service*)—In telephone systems with several exchanges the service between exchanges over the interoffice trunks has to be figured out. This service must be estimated in both directions, coming and going, also as to its traffic per hour. Further the ratio between traffic per day and heaviest traffic (HT) must be obtained, as also what percentage of these calls comes under outgoing traffic. The number of trunks needed to met all requirements of IT-traffic must be noted down, as also the maximum number of trunks found busy during the HT-hour and the number of calls distributed over the various trunks. For each 1,000 connections the exact time must be obtained, during which the trunks were busy with each call and the average must be computed from these figures. The extent of the IT-traffic can also be found with the aid of the following equation: $V = c. \frac{(S - s_a)}{S} . s_a$; $V_b = c. \frac{(S_a . S_b)}{S}$ In this equation: V = the total IT-traffic between the exchange A and all the other exchanges in the city, both in the outgoing and incoming direction. S = the sum of the calls starting out from all of the other exchanges in the city. s_a = the number of calls starting out in exchange A. V_b = the IT-traffic from exchange A to exchange B. S_b = the number of calls starting out from exchange B. c is a factor which expresses the measure in which the telephone conversation relations, which we may expect theoretically, exist in actual reality. This factor c varies according to the business or private relations of the subscribers to each other, between 0.5 and 1.5; at times it is about 0.75, probably the most common figure. The further the two exchanges are apart, the smaller will c be. If the exchanges should be housed in the same building, the value of c approaches 1. The values vary again, if for example one exchange houses primarily connections which are used for business purposes, while the other exchange has more private traffic. The value c should be tested as far as possible in conformity with actual traffic conditions. The traffic between two exchanges in outgoing and in incoming directions is in general equal; in the direction from the smaller to the larger exchange, likewise from exchanges situated in a residential quarter to exchanges in business quarters it is usually larger.

C. Long Distance Traffic: The following facts must be obtained in relation to the work of the L. D. operator: Number of trunks used for recording long distance calls. Number of long distance calls for each hour of the day. Number of return questions for each hour of the day. Number of operators busy during the HT-hour for long distance calls. Ratio between daily long distance traffic and long distance traffic during HT-hour kept separate for calls and return questions. Number of telephone calls completed by the long distance operator during each hour. Number of inquiries coming to this operator for every hour. The last two factors are likewise obtained for the HT-hour of service.

Factors covering long-distance traffic are computed in three groups, by incoming, outgoing and way-station service. These facts must be obtained for each hour of the day, also in ratio of average hourly service to HT-service. It is very hard to obtain a law to meet the needs of development in long distance traffic. The position of the city, its importance in the surrounding industrial and commercial life, its distance from other industrial and commercial centers will be large factors in this study of long distance traffic conditions in other cities having a similar location and economic life. It is necessary to find out how many long distance calls, both incoming and outgoing, fall to the lot of the various local telephone lines, during the traffic hours per day. In towns with a smaller factor of this type a greater increase in long distance calls may be estimated for the future than is the case in towns where the present traffic figure seems to approach a saturation point. Further, the traffic over shorter distances seems to grow much more rapidly than traffic over greater distances.

In addition the number of lines, both physical as well as phantom circuits must be figured in the estimate of the expanded long distance traffic. By the use of the figures obtained for long distance traffic during the entire day and during the HT-hour it can be determined how many calls (total and separated into three groups) go to each LD-line, both for the day and for the HT-hour. It is also important to know the number of LD-operators busy during the heavy traffic hour, as also the number of LD-trunks terminating at each LD-operator's place. The number of calls, both outgoing and incoming, should be determined for each LD-operator separately. In order to obtain an approximate figure for the time devoted to each call, about 1,000 calls should be accurately counted as for time and an average struck for each call from that total. From the total traffic and the number of LD-operators the average traffic can be figured for each operator. Finally it must be determined how traffic and telephone lines are distributed over the various toll charge zones; how they are distributed over the HT-hour for each zone and how the average load and the amount of work needed for each call is distributed.

The facts obtained from the above determinations are now applied in specific instances in the following manner:

I. Local Exchange Equipment: The multiple switchboard equipment with all its accessories is determined from the number of subscribers' lines which terminate at the exchange in question. On this depends the type of equipment to be used for the main and intermediate distributing frames. If less than 3,000 connections are expected, the multiple switchboard equipment is

connected to a one-place multiple switchboard, in all other cases they are united at three-position switchboards for 10,000 connections. For exchanges up to 3,000 lines a joined main and intermediate distributing frame can be used, while the larger exchanges use separate frames of each type.

If the type of switchboard has been determined, the number of the various portions of the equipment is determined, estimating the equipment for the present needs separately from the needs after fifteen years' development. When figuring on the present needs the following points should also be observed: In small exchanges with single operator switchboards, additional equipment can be installed very easily, because the switchboards are units, complete within themselves; it matters little, therefore, if the equipment at first is figured rather scanty, as it can be developed very easily and without great expense. In large exchanges, especially where there are several exchanges in the system, development of equipment is connected with much trouble and expense and usually brings with it reactions on the efficiency of service, so that it is advisable to figure liberally in order to save expansion until a late date. An exceptional case is where changes within the local system are to be made, like opening a new exchange in some central position of the city, and where the needs of the IT-service cannot be estimated very accurately. Here the needs of the exchange should be figured closely, so as to avoid equipment lying idle, bringing in nothing on the investment, after the new exchanges have been opened.

1. *Main Distributing Frames*: The inner side of the main distributing frame with the strips for cable terminal connections must be of sufficient size to hold the cables that will end there even after fifteen years of development. An addition of 5 per cent should be made for such lines that cannot be used temporarily, such as temporarily disconnected subscribers' lines, connections left open for subscribers, whose probable growth will make them needed in a short time, etc. The outer side of the frame with the safety fuse banks at which the outside cables terminate is figured for the same number of terminals as the inner side, only that an addition of 25 per cent for extra space is made, leaving room for spare wires. This surplus space for the outer side is always given in the ordinary switchboard main distributing frames, in that a bank of fuses on the outer side always corresponds to a strip of connections on the inner side of the frame. The latter here holds twenty wires, while the outer bank always has room for twenty-five connections. If the excess of outer cables promises to be more than the figured 25 per cent, as often happens when first expanding an exchange, the outer side will have to be enlarged in proportion. This can be done, for example, by attaching to each vertical section of the frame six banks of fuses, but only five strips on the corresponding horizontal section of the frame. Outer and inner lines will have a ratio to each other in this case as 150 to 100.

If IT-service passes through the exchange, room must be left on both sides of the frame for the interoffice trunks. The same is true of toll lines, unless the long distance switchboard is in the same building. In smaller exchanges it is advisable to pass the long distance wires as well over the main distributing frame; the inner side of the frame will then serve at the same time to house the subscribers' interoffice trunk, toll, and long distance lines. The various groups of lines must be arranged so that each can be expanded individually without disturbing the other. What has been said here refers likewise to the drop signals, which show that a fuse has been blown by a high potential current.

2. *Intermediate Distributing Frame*: Connections are made from the horizontal side of the main distributing frame to the vertical side of the intermediate frame and the cables pass on from the connecting strips at the latter to the multiple subscribers' panels, to the call and cut-off relays and to the call counters. Consequently the vertical side of the intermediate frame must have the same capacity as the horizontal side of the main distributing frame. The horizontal side of the intermediate frame might perhaps be kept smaller by about 5 per cent, as only the lines of subscribers that are in actual use need be connected to the answering jacks. Other reasons, however, demand a certain surplus. If, for example, we find that each A-position is to be used for serving perhaps 115 MR-service lines, the above saving cannot be made easily, because the call lamps and the call jacks are commonly built into the switchboards in strips of ten each, so that we will have to figure on 120 MR-service connections for each place, instead of the actual 115. An advantage in leaving space for expansion also saves trouble later on, when the load of traffic becomes heavier and when it is, therefore, easier with surplus places to distribute the extra load in a better way, without necessitating extensive changes at the intermediate frame. The horizontal side should therefore be made at least as extensive as the vertical side; an added surplus of 5 to 10 per cent is of decided advantage.

3. *Relay Frame*: The relay frame should be figured for the same number of lines as is to be housed at the vertical side of the intermediate frame. Aside from the call and cut-off relays for the local subscribers' lines, room must be left for the relays of interoffice trunks and toll wires, unless these have a separate frame, as is the case in many exchanges with larger service.

4. *Counter Frame*: The counters are placed either at the relay frame itself above the relay strips or at special counter frames. The doom for them depends on the number of lines that have individual charge call service with the probable amount of growth in the years to come.

5. *Safety Fuse Frame*: The number of fuses for the relay frame must be figured as well as the fuses needed for the multiple switchboard equipment and thus the size of the frame to hold the banks of fuses can be found.—*Fernsp. Tech.*

(*To be continued*)

TELEPHOTOGRAPHIC SERVICE BETWEEN BERLIN AND CONSTANTINOPLE

Dr. Korn proposes to introduce television along with telephone and telegraph service as a new means of international news service. The route is to be Berlin-Vienna-Budapest-Sofia-Constantinople, thus linking the North Sea with the Indian Ocean by a new way. A section of the telegraph and telephone line is to be utilized for the scheme; part of this is now used for high speed communication and part for Siemens ticker service.

As regards the television service by way of telephone lines, one might use at once the exchanges at Vienna and Budapest connecting them to the Berlin long distance exchange. To transmit a picture from Berlin to Vienna the use of the telephone lines for fifteen minutes would be sufficient. The transfer of the communication into an actual picture would enable news that happened at Berlin in the afternoon to be published in picture form in Vienna next morning.

Transmission over longer distances, as Berlin to Constintinople, would take place over the telegraph wires

and the Siemens high speed telegraph instrument now in use between the two cities. It would take a little less than an hour to transmit a picture from one city to another.

The principal expense would be the use of the telegraph and telephone lines. The governments of the countries involved may, however, quote special rates for the television service, provided the pictures are sent over at times when ordinary traffic is low. The other costs are not very high and would not be more than $1,200 to $1,500 for a complete equipment at each station. Each station would also have to be supplied with an engineer and a mechanic, for which service the members of the regular telephone or telegraph staff might be used after training them in this work. They could easily do the work required in their off hours. The cost of current and photographic material is very slight.

The project can be carried out if the chief journal or paper printing pictures and having telegraphic news service would take hold of the matter; a new means of communication would be opened, which in time would be a good commercial proposition.—*Annales des Telegraphes.*

APPARATUS TO MEASURE TELEPHONE CIRCUITS

The apparatus shown in Fig. 1 and used by the French Department of Telephones and Telegraphs for research work consists of shunts without inductance and permits currents to pass across the graduated portion of the instrument. This current may be of any amount and to any minute fraction and is expressed in a fixed dial, the measured fraction being indicated with the aid of a switch, which is turned until a balanced condition of the apparatus is obtained.

The object of the apparatus is to give a quantitative reading of the intensity of a telephone current used in conversation, which passes over a telephone circuit or else through any kind of telephone instrument. Such a measurement has become very important since the use of Pupin coils and of composite circuits.

The instrument is composed in part of resistances connected to contact discs, disposed as the figure and diagram indicate and brought into the circuit by a rotating switch of very feeble resistance.

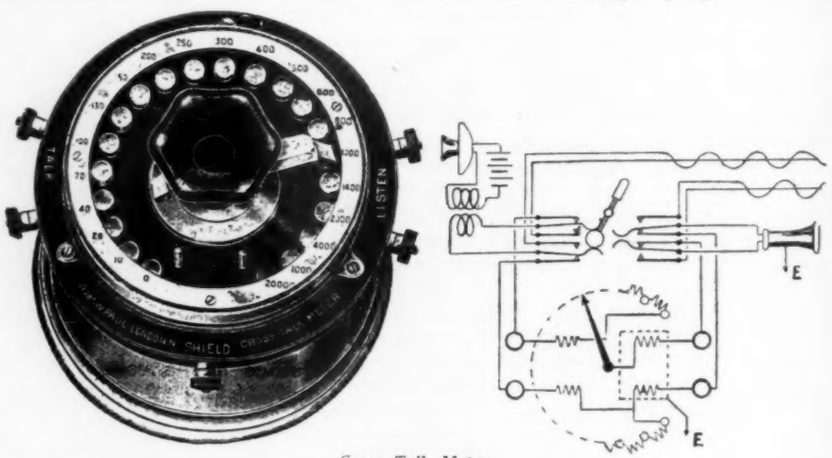
The diagram shows the instrument with the two-way switch, which connects the apparatus either with the transmitter or the receiver, when testing a pair of conductors in a cable. In the figure, the switch is thrown over so as to connect the transmitter to the testing instrument, the variable portion of the shunts being connected to the receiver. In reversing the position of the switch the transmitter is connected to a pair of wires in the test cable, while the other pair is connected with the receiver. The test is taken by regulating the position of the rotating switch so as to obtain equal clearness of conversation and hearing in both positions of the switch. The resistance can be regulated and varied so as to give the total of 20,000 units or else of only 4,500 units.

To make accurate tests the connections must be made with covered conductors so as to avoid the possibility of cross talk in the cross talk meter itself. The receiver must also be protected. The coils of the receiver are in a grounded metallic case. The switch, the transmitter, the protected receiver and the induction coil are furnished separate in a portable case.—*Annales des Telegraphes et Telephones.*

IMPROVING FRENCH LONG DISTANCE SERVICE

In order to improve the speed and efficiency of long distance service between important French cities, the Telephone Department recently started a system, used quite some time in America, whereby communication between long distance operators is carried on by telegraph (Morse code) instead of by the telephone. The advantage lies in the fact that the operators need not wait until a call has been definitely made before beginning on a second call, but can receive the required number for the new call over the telegraph instrument. The service was much improved by this innovation, as new calls were immediately switched to the wires, after the previous subscribers had hung up their receivers. The wires were therefore always busy and the revenues were greater, while the speed with which service was established was welcomed by all business men in the two cities involved. On the other hand the expense of the new service was minimum, since telegraphic communication is furnished by the telephone circuits which are ordinarily also used for telegraphing.

To obtain all the advantages to be derived from this practice, care had to be taken to furnish to operators no more circuits than they could handle in even the busiest time of traffic. To this end a new grouping of circuits had to be undertaken. The operators also had to do their share in order to meet the aims of the department.



Cross Talk Meter.

The first improved service was started between Paris and Lyon, and later between Bordeaux and Marseilles. The usefulness of each circuit in these cities was increased from thirteen to twenty-nine communications per hour. In fact, the number of daily calls, which before this service was inaugurated was on the average 550, has passed the 750 mark; and waits for open wires, which before this had been as high as two hours, have practically disappeared. Telephone traffic has not even reached the maximum capacity of which the wires are capable, so that open circuits are found even at the time of heaviest traffic. Unhappily the war has prevented this improvement becoming better known to the general public, partly due to the restrictions placed on private communications by the military administration.—*Annales des Telephones.*

Semi-Automatic Operation, Landskrona, Sweden

Description By J. Hedley of the Institution of Post-Office Electrical Engineer, London

IN the year 1915 a semi-automatic exchange was installed in Landskrona, Sweden, by the Western Electric Company—one of several European plants now equipped with that company's new system. In this paper no attempt is made to describe the Landskrona exchange itself; it is merely used as a base for explanation of a semi-automatic system which, as yet, is little known in this country.

There are several features peculiar to the Western Electric Company's system, which have been introduced after many years of close study of the common battery manual conditions of operating. Briefly, these features provide for (*a*) all classes of originating traffic being dealt with in a similar manner; (*b*) for the operators' load to be equalized automatically; (*c*) for supervision to indicate the progress of each call; and (*d*) for automatic registration of the call when the connection is released.

At this stage, it is thought the clearest indication of the facilities available will be obtained by a statement of the equipment provided on each position, followed by a description of the circuit arrangements.

Fig. 1 shows the keyboard equipment in the Landskrona exchange. It will be seen that each semi-automatic operator's position is provided with:

30 connection circuits, each fitted with:—

A calling lamp *CL* to indicate the receipt of an originating call from a subscriber.

A ringing lamp *RL* to indicate the progress of the call until the called subscriber replies.

Two supervisory lamps *AS* and *CS*, to indicate when the calling and called subscribers replace their receivers.

A combined listening and release key. The listening position *LK* is used by the operator for supervising in case of difficulty, and speaking to the subscribers after the connection is established, if necessary. The release position *RK* is used to release the connection upon completion of the conversation, when both supervisory lamps glow; the operation of this key also registers the call against the calling subscriber.

The equipment common to the position comprises:—

A set of number keys, associated with two register circuits. The keys are depressed by the operator, according to the information received from the calling subscriber; the register circuit accepts the impulses from the number key circuit, and establishes connection with the called subscriber.

A pilot calling lamp, as a guard against individual calling lamp failures.

A master release key *CRK*, used in conjunction with the release key *RK*, to enable the operator to break down a completed connection when the calling subscriber fails to hang up his receiver. The unintentional operation of the release key alone, will not sever the connection, thus "cut offs" are obviated.

A master non-metering key *CMHK*, used in conjunction with the release key to enable the operator to sever wrong connections, without metering.

A master hold over key, used in conjunction with the listening key when faulty connections occur; to release the subscriber and hold the automatic switches in use to enable the test clerk to trace the fault; faulty switches thus receive attention immediately they come under notice.

A master lamp glow key *PSK*, to enable permanent signals on subscribers' lines to be transferred to a special position; this frees the semi-automatic operator's position for normal traffic without delaying the operator, and transfers the lengthy process of testing and observation necessary for such lamp glow faults, to a special operator.

A master wipe out key *WOK*, to enable the keyboard sender to be released in the event of the operator's depressing the wrong numbers. This key is effective if operated before the whole of the digit keys are depressed.

Two helping out keys *N₁CK*, *N₂CK*, to enable the operator to complete on her keyboard equipment, calls associated with the connection circuits on the adjacent operator's positions.

One telephone circuit, arranged so that calls can arrive at the position only when the telephone plug is inserted.

Two feeder sequence switches and one timing sequence switch, arranged so that the position is free to receive one call every 4 seconds approximately.

Briefly, the operation of a call is as follows:—

The receipt of a call is notified to the operator by a slight momentary buzz in her telephone, the lamp of the calling subscriber flashes to indicate the connection circuit associated.

The operator whose telephone is automatically placed in circuit replies "number please," repeats the number obtained from the subscriber, and depresses the corresponding digit buttons on the keyboard sender.

The operator is now free to supervise her keyboard, release connections, or deal with the next call.

It should here be noted that the only manual operation required to be carried out by the operator up to this point has been the depression of the keys on her keyboard. The elimination of the fatiguing operations will thus be apparent.

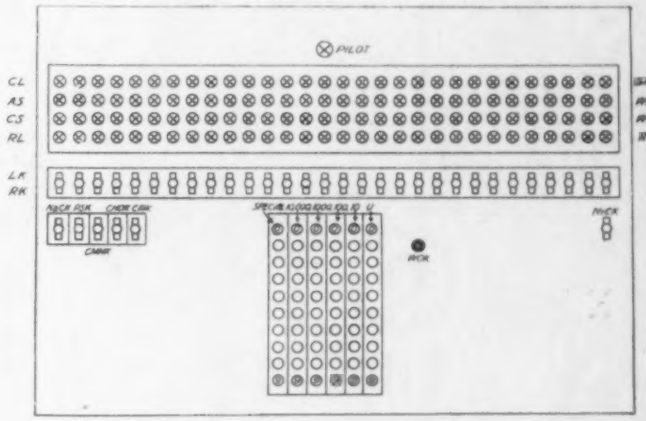


Fig. 1—Operator's Keyboard Equipment.

From this point onwards the various types of calls are completed by the automatic equipment in the following manner:

1. *Local Calls.* Automatically as in a full automatic exchange. Local non-fee junction calls to another semi-automatic exchange will also be completed automatically similar to local calls.

2. *Local Non-fee Trunk Calls to C.B., C.B.S., and Magneto Manual Exchanges.* An office key is depressed in advance of the number required, the office key finds the idle junction, and the subscriber's number is displayed before the distant exchange operator, on a number indicator. This system is known as the "carriage call" and will be referred to later.

3. *Toll Trunk Calls.* The number is displayed before an operator at a special ticket position of the jack ended junction type in the semi-automatic exchange. This operator asks the calling subscriber for his number and if possible at once completes the call manually, making a record on a ticket.

4. Number busy calls from measured rate subscribers may, if desired, be automatically transferred to an operator at a special position in the semi-automatic exchange. The latter operator informs the subscriber that the number is busy and, if desired, completes the call later. Automatic equipment is provided

whereby the calling and called subscribers are rung only when both are disengaged. The calling subscriber may also originate and receive other calls in the usual manner, while waiting for the number busy call to be completed.

The remaining classes of traffic are dealt with specially as follows:—

5. Calls for information, test, trunk recording operator, are established by the semi-automatic operator depressing a single button; when the release key is thrown such calls are not registered against the calling subscriber.

6. Calls for phonogram are also established by the depression of a single button; upon release, the call is registered against the calling subscriber.

The following supervisory facilities are afforded to the operator:—

1. After the depression of the number keys, supervisory ringing lamp *RL* will flash until the call has progressed through the automatic plant to the called subscriber, or distant operator.

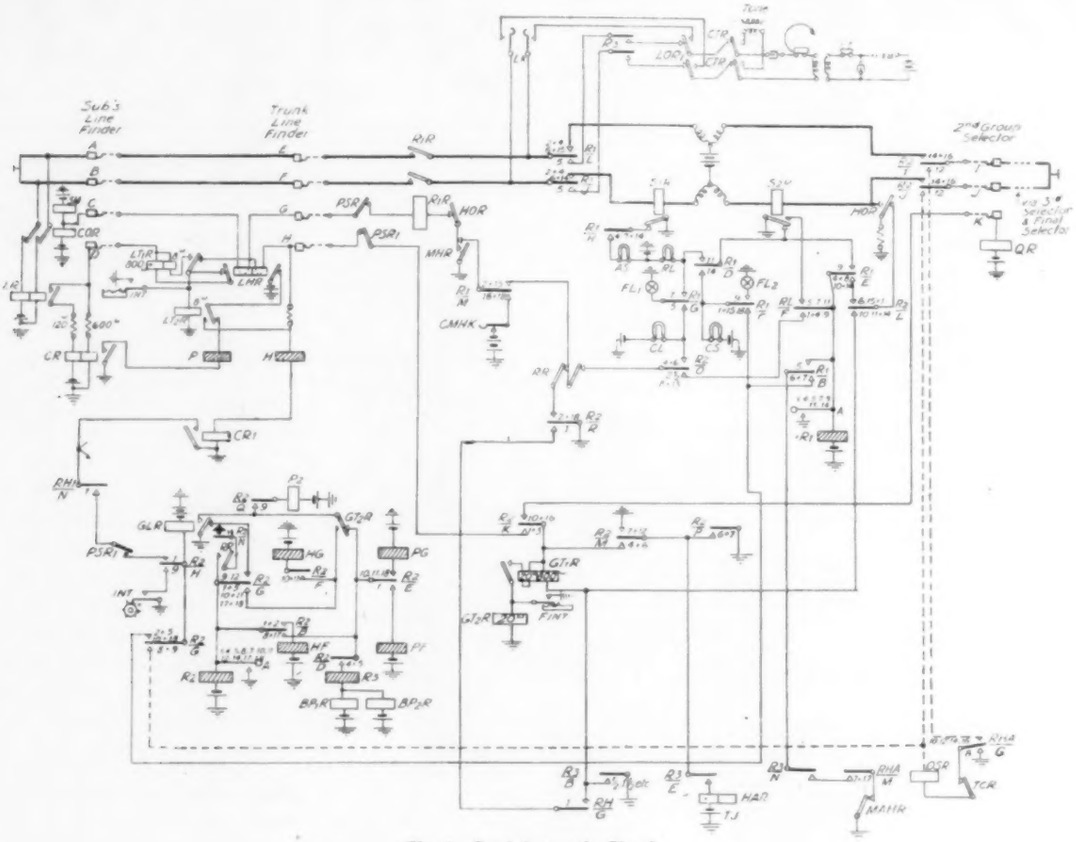


Fig. 2—Semi-Automatic Circuit.

2. When the called subscriber's line is found, *RL* will glow steadily until the called subscriber replies.

3. Upon completion of the conversation supervisory lamps *AS* and *CS* glow as an indication to the operator to throw the release key; this operation releases the connection, and registers the call automatically.

4. The subscribers can flash the supervisory lamps to gain the attention of the operator during a connection in the usual manner.

From the foregoing, it will be evident that the underlying principle throughout is one which has for its object the standardization and simplification of the work to be done by the semi-automatic operator for all types of calls, at the same time giving the operator complete control of the connection, with full indication during its progress.

Before proceeding with the circuits, a brief statement of the arrangement of the subscribers' numbers on the various switches will enable the progress of a call to be followed more clearly.

Table I shows the subscribers' numbering scheme. It will be seen that each level on the first group selector accommodates 20,000 lines; these levels will be reached according to the ten thousands digit. The second group selector levels accommodate 2,000 lines and refer to the selector of the particular thousand. The third group selector levels each accommodate 200 lines, and the final selector levels 20 lines, for the units digits for even and odd hundreds. It is unnecessary for the subscriber's number to be changed to 5 or 6 figures, as the case may be; the usual 4 figures with the office prefix is the maximum required, irrespective of the size of the semi-automatic system. The automatic circuits can be arranged so that the depression of a single office button completes the circuits of the first one or two digits required to reach the correct levels, *e. g.*, Mayfair 4364 instead of 44364. I propose dealing with a call to 44364, *i. e.*, the fifth level first G. S., fifth level second G. S., third level third G. S., seventh level F. S., and fifteenth contact—*i. e.*, Fig. 4 for an odd hundred.

SUBSCRIBER TAKES RECEIVER OFF—FIG. 2.

(1) Relay *LR* energized around subscribers' loop.

(2) Starting relay *CR* operates *via* contact of *LR* and driving magnet *P* operates *via CR*, the group of 1st line finders rotate and hunt for the calling line.

(3) When line found, relay LT_1R operates *via* brush *D*, and when the brushes are centred on the terminals of the line, the ground on *INT* is disconnected, relay LT_2R then also operates, the calling subscriber's line now tests busy to all other line finders, as relays LT_1R will not operate, when shunted by the low resistance windings of LT_1R and LT_2R. As a further guard

against double connections, 2 relays LT_1R will not operate simultaneously should two line finders reach a calling line simultaneously.

(4) Operation 3, disconnects P and operates holding magnet H to stop the brush carriage on the terminals of the wanted line. Starting relay CR_1 also operates in series with H.

(5) Relays GLR of idle 2nd line finder and group selectors now operate *via* H_1 of R_3, contacts of PSR_1, N_1 of RH_1 *and* CR_1.

(6) 2nd L.F. driving magnet PF operates *via* E_1 of R_3, contacts of GT_2R and GLR—2nd L.F. rotates to find the 1st L.F. connected to the calling line.

(7) When line found, test relay GT_1R operates *via* branch circuit over brush H, contacts PSR_1, K_1 of R_3, relay GT_1R, G_1 of RH and R_1 of R_2.

(8) When the brushes are centred on the line, the ground on $FINT$ is disconnected, and relay GT_2R also operates. The line now tests busy to all other 2nd L.F. as relay GT_1R 800ω winding will not operate in parallel with the low resistance windings of GT_1R and GT_2R.

(9) PF, now disconnected and holding magnet HF, operates to stop the brush carriage on the terminals of the calling line.

(10) Sequence switch R_2 also operates and moves to position 4, thus causing the calling lamp CL to glow, from battery CL, O_4 of R_3, RR, R_4 of R_2 to ground.

(11) In position 2 of R_2, HF released, in position 3, GT_2R and GT_3R released.

In position 2½ of R_2, R_1 is energized *via* F_1 of R_1, O_2 ½ of R_3, RR and R of R_2, R_1 moves to position 4, GLR is maintained *via* G of R_2, C of R_1 and C.S. lamp.

(12) In position 2 of R_1, relays COR, LHR, and R_1R are operated *via* brushes C and G, contacts PSR, HOR, MHR, M_2 of R_1, RR, and R of R_2. The meter SM is not operated at this stage.

(13) The operation of COR releases LR, LT_1R, LT_2R, and CR, and stops the hunting 1st L.F.

(14) The operation of LHR releases H and CR_1, and stops the hunting 2nd L.F.

(15) The operation of R_1R connects the subscriber's line to the answering side of the connection circuit and supervisory relay S_1R is operated.

(16) In position 4 of R_2, R_3 is energized from battery BP_1R, BP_2R, R_3, D of R_3, GT_2R and GLR to ground rotates for a free register.

(17) When free register found, relay HAR, HA_1R and GT_3R are energized from battery, telephone jack TJ, contacts LOR_2, R of register, HA_1R, O of register, HAR, E of R_3, M of R_2, GT_1R, and B of R_3. See Fig. 6.

(18) The operation of HAR completes the circuit for register RHA and moves it to position 6, where it remains until the number keys are depressed by the operator. See Fig. 3.

(19) The operation of HA_1R holds HAR, in case the operator throws the listening key and operates LOR_2, before HAR locks *via* its left contact. See Fig. 6.

(20) In passing positions 5 of RHA, CTR operates momentarily and a tone is connected *via* induction coil CT. This buzz notifies the operator that a call has arrived. See Fig. 3.

(21) When GT_1R operated, GT_2R is also energized and R_3 is disconnected. R_2 is then also operated and moves to position 8. GLR is now released.

(22) In position 6 of R_2 GT_1R and GT_2R are short circuited at P of R_2 and they release.

(23) In position 6 of R_2, R_1 is energized via E of R_1, L of R_2 *and* HOR. R_1 moves to position 5 and the calling lamp CL now flickers from interruptor FL_2, G of R_1.

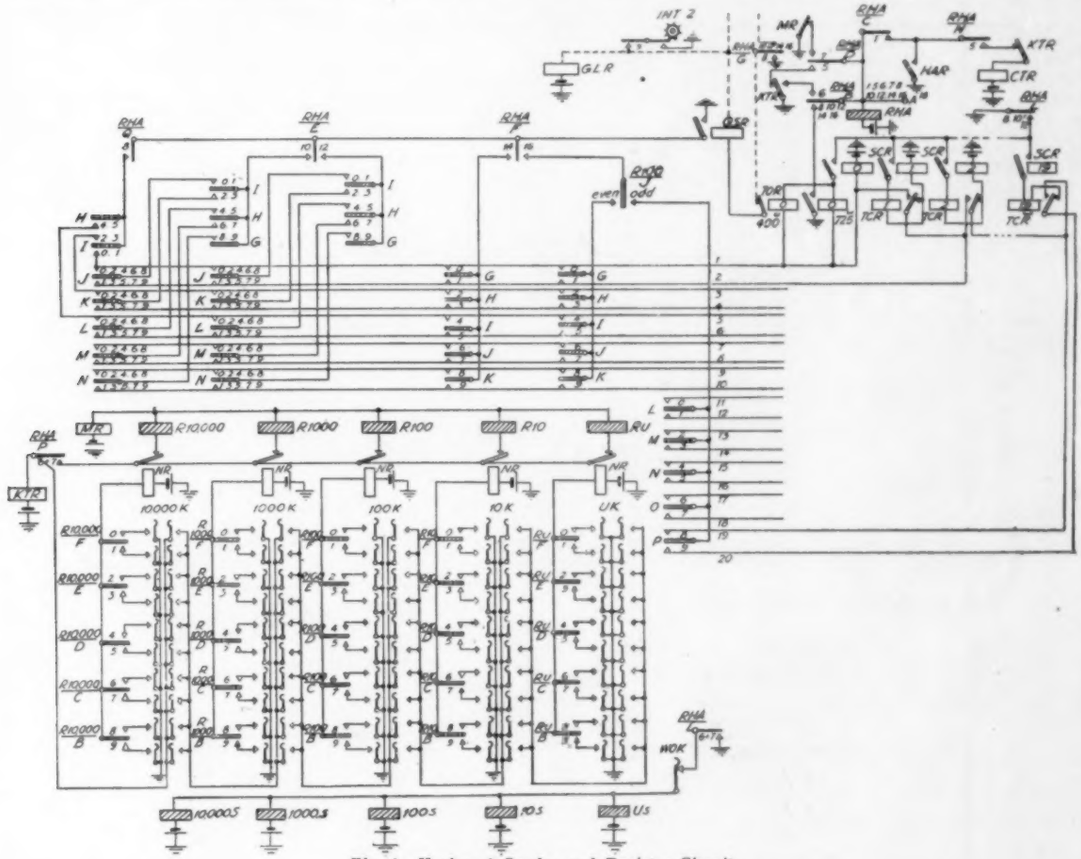


Fig. 3—Keyboard Sender and Register Circuit.

(24) The operator's telephone is now automatically associated with the calling subscriber's line, *via* contacts CTR, LOR_1, R_3, J_3 and L_3 of R_1, etc.

The sequence switch positions are now

R_1	R_2	RHA
5	8	6

(25) R_1 moves to position 7 when keys depressed and supervisory lamp RL then flashes.

(26) R_2 moves to position 9 and operates trip spindle P_3, which is set to trip the correct set of brushes.

(27) R_2 then moves to position 10 to operate the brush carriage PG to find an idle trunk to 2nd group selector.

(28) R_2 moves to position 12, after free trunk found, to join up the fundamental circuit to the succeeding selectors.

(29) When line wanted is found R_1 moves to position 11 *via* F of R_1 and S_2R, RL glows steadily, thus indicating to the

operator that the called subscriber is being rung. R_2 also passes to talking position 14.

(30) When subscriber answers, RL is extinguished and R_1 moves to its talking position No. 14.

(31) When the conversation is completed, S_1R and S_2R are de-energized and both supervisory lamps AS and CS glow.

OPERATOR DEPRESSES THE NUMBER KEYS—FIG. 3.

(1) Assume keys 44364 have been depressed. Keys attracted by their correspondence magnets *via* wipe out key WOK and L_8 *of* RHA. The wipe out key is provided in this circuit to enable the keys to be released, if the wrong buttons are depressed, provided all the keys have not been operated.

(2) When all keys are down, KTR operates *via* springs of all keys to earth, this moves RHA to position 7 *via* RHA/B.

(3) R_1 now energized *via* B_8 of R_1, R_3, M_7 of RHA and of R_2, contacts GT_2R and GLR. In this position the trip spindle P_2 is energized *via* Q_9 of R_2 and GLR. See Fig. 2.

(10) As P_2 rotates, INT_2 grounds its springs and short circuits OSR, which releases. SCR_4 is now maintained *via* TCR_4 $\frac{RHA}{L}$ and TCR_4 is now energized.

(11) When OSR is next energized, SCR_3 will be operated *via* contacts of TCR_3 and TCR_4, etc. These operations will continue until both relays TCR-O are operated in series with SCR-O *via* contacts of SCR-O and RHA.

(12) The operation of TCR-O 400ω disconnects the fundamental circuit and SR remains de-energized, and when the trip spindle removes its ground GLR is also de-energized, thus stopping the trip spindle P_2, in a position to trip the brushes for the 5th level as required.

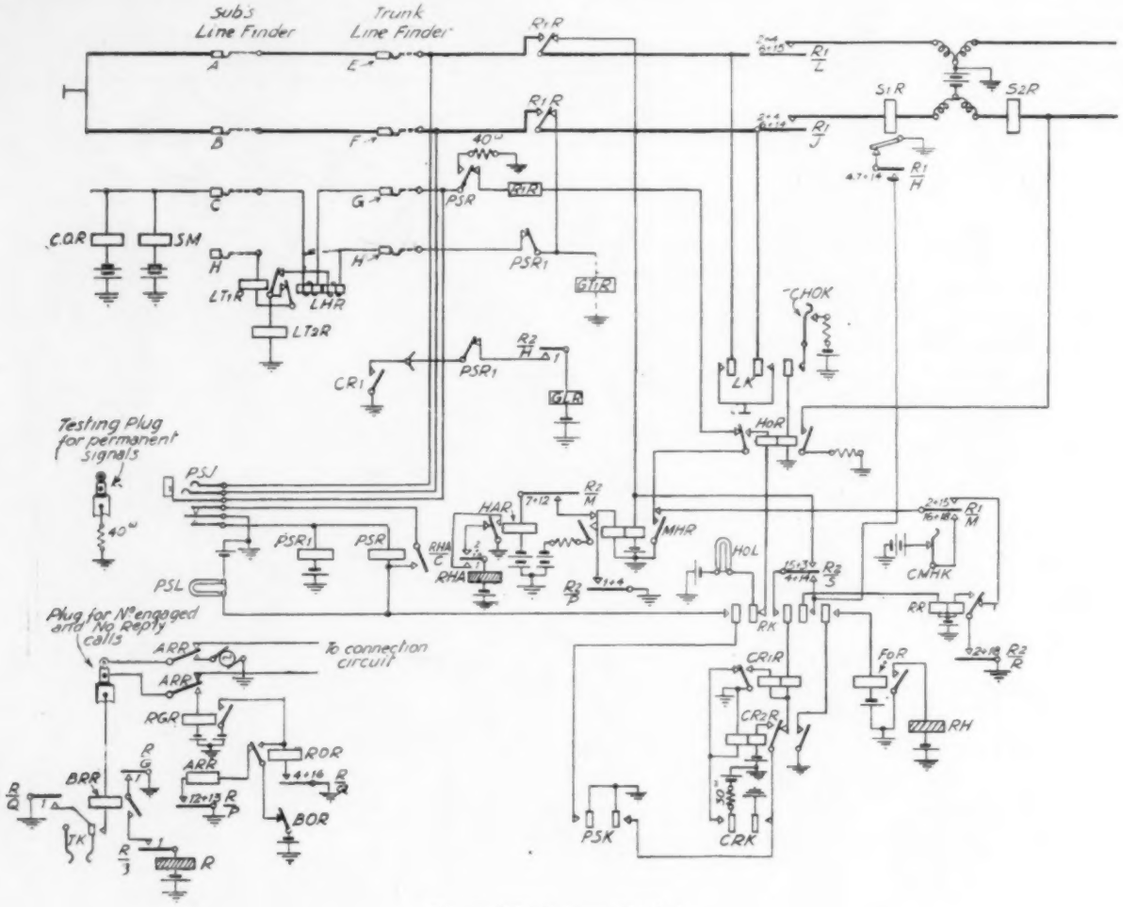


Fig. 4—Miscellaneous Services.

$MAHR$. R_1 moves to position 7, disconnects the operator's telephone at J and L, and flashes lamp RL at G_7. See Fig. 2.

(4) The depression of the keys also completes the circuit of MR and the numerical registers $R_{10,000}$, $R_{1,000}$, etc., *via* P of RHA and keys. The operation of MR prevents RHA from moving out of position 7. The numerical registers rotate until they reach the position of the numbers set up, when all relays NR operate. This stops all the registers and de-energizes MR.

(5) RHA operates *via* MR and moves to position 8, thus releasing the number of keys, which in turn disconnects KTR and NR. The number keys are now free for use with register RHB.

(6) Register RHA, which is associated with the connection circuit, is now ready to count impulses.

(7) In position 8 of RHA, GLR and OSR operate *via* G_8 of RHA.

(8) OSR provides a circuit for the counting relays, *via* Q_8 of RHA, H_8 of $R_{10,000}$, lead 5, contacts of TCR_4, relay SCR_4 to battery, energizing SCR_4.

(9) The operation of GLR moves R_2 to position 9 *via* B_9

(13) R_2 now moves to position 10 *via* C_9 of R_2 and GLR (see Fig. 2).

(14) The ground on TCR-O 725ω shifts RHA to position 10 *via* B_8 of RHA, thus releasing all the counting relays, as ground removed from L_8 of RHA. The counting relays are thus available for the next set of impulses.

(15) In position 10 of R_2, GLR again operates *via* G of R_2, B of R_1, N of R_3, and M of RHA, thus energizing PG, *via* E_{10} of R_2. Brush carriage rotates, the trip spindle trips the correct set of brushes for 5th level in this case and the 1st group selector searches for an idle trunk to the 2nd group selector. When free trunk found, GTR operates, *via* brush K, L and K of R_2—HG now energized, also R_2 which moves to position 12 to complete the next fundamental circuit. See Fig. 2.

(16) The counting relays are operated in a similar manner for the remaining digits in the registers, and so the switches are controlled to reach the called subscriber's line. The circuits of the final switches, etc., are similar to

(17) For the 1000's digit, 4, the counting relay circuit will be completed, from contact OSR,

$$\frac{RHA}{E_{10}}, \frac{R_{1000}}{H_4}, \frac{R_{100\,00}}{L_4},$$

lead 5 contacts TCR_5, relay SCR_5 to battery, etc., again finding the 5th level of the 2nd group selector for 4000-5999 group of subscribers as required.

(18) For the 100's digit, 3, the above circuit will be *via*

$$\frac{RHA}{E_{12}}, \frac{R_{100}}{13}, \frac{R_{10\,00}}{K_4},$$

lead 3, contacts TCR_3, relay SCR_3, etc., finding the 3rd level of the 3rd group selector, for 200-399 group of subscribers as required.

(19) For the 10's digit, 6, the counting circuit will be *via* $\frac{RHA}{F_{14}}, \frac{R_{10}}{J_6}$. lead 7, contacts TCR_6, relay SCR_6, etc., finding the 7th level of the final selector for 60-69 group of subscribers as required.

(20) For the units digit, 4, of an odd hundred as in this case, the circuit will be *via*

$$\frac{RHA}{F_{10}}, \frac{R_{100}}{J\text{ odd,}}, \frac{RU}{N_4},$$

lead 15, contacts TCR_{14}, relay SCR_{14}, etc., finding the 15th contact, *i. e.*, 64 for an odd hundred as required.

ORDINARY RELEASE—CALL REGISTERED. FIG. 4.

Upon the cessation of a completed call relays S_1R and S_2R are de-energized and both supervisory lamps *AS* and *CS* will glow. The operator then depresses release key *RK* and relay *RR* operates *via* key *RK*, H_{14} *of* R_1, S_1R to ground. *RR* locks *via R* of R_2, and R_2 moves to its home position 1.

In position 15 of R_2, R_3 is energized *via E* of *R*. *L* of R_3 contacts of *HOR* to *E*, and moves to its home position 1. (See Fig. 2).

When R_3 passes from position 16 to 18, the booster meter battery circuit is completed *via M* of R_3, *MHR, HOR*, relay R_3R, brush *G, LHR* service meter, *SM* and *COR* to battery operating *SM* and thus registering the call.

ORDINARY RELEASE—CALL NOT REGISTERED. FIG. 4.

In the case of a wrong connection, the subscriber may not require the call to be proceeded with. The operator will therefore require to release the connection without metering.

RK and common meter hindering key *CMHK* are in this case held depressed simultaneously, for a short period. *RR* operates and releases the connection as before, but when R_3 passes from position 16 to 18, the circuit of the booster meter battery is disconnected, and the switches return to normal without metering.

FORCED RELEASE—CALL REGISTERED. FIG. 4.

If the originating subscriber fails to restore his telephone after completing the conversation S_1R will remain operated, and in order that the operator may release the connection and meter the call, the following operation takes place:—

Common release key *CRK* is first depressed and then release key *RK*.

This operates *RR viâ RK, S* of R_2, *RK*, CR_1R, CR_2R, and *CRK* to earth, and releases the connection, as previously described, metering the call in the usual manner.

FORCED RELEASE—CALL NOT REGISTERED. FIG. 4.

In the case of a wrong connection, the operator may desire to release without metering, and at the same time bring the call back on the same connection circuit. *CRK* and *RK* are depressed simultaneously and held operated until the calling lamp glows again.

RR is operated as before and release commences, CR_1R is also energized and locks *viâ* its front contact. This removes the short circuit from CR_2R, which operates and locks *viâ* its front contact.

The operation of CR_1R also completes the circuit of the meter hindering relay *MHR, viâ S* of R_3, in position 15 to 3, thus preventing the call being registered whilst releasing. The earth on contacts of *MHR*, replaces the fundamental earth and holds R_1R, the connection circuit therefore remains associated with the calling subscriber's line.

The operation of CR_2R energizes *FOR*, and steps *RH* out of position 1 to keep the operator's position busy until the call returns. (See Fig. 5).

Sequence R_2 returns home, but as the subscriber is waiting, R_3 at once goes to position 4 and the calling lamp *CL* glows on the same connection circuit, to signal the operator to release the keys *CRK* and *RK*. The operations will now proceed as for a normal call.

MHR and CR_1R release when R_3 passes position 3, and CR_2R is disconnected when key *CRK* is restored to normal.

LAMP GLOW FAULTS. FIG. 4.

In Manual C.B. exchanges, the existence of a permanent calling signal does not interfere with the work of the answering operator. A plug can be inserted in the answering jack and the call supervised from the cord circuit suupervisory signals, until it is considered desirable to report the circuit as faulty to the exchange testing operator, who tests the line and applies the howler. In a semi-automatic exchange a permanent calling signal renders the operator's position engaged to all other calls, and it is therefore essential that such faulty circuits shall be transferred rapidly.

Lamp glow faults may be due to (*a*) subscriber leaving off his receiver; (*b*) slow answer; or (*c*) a definite fault. The first two cases can usually be cleared up by the manual board testing operator, and if the traffic requirements stipulate that lamp glow faults in a semi-automatic exchange shall be transferred to a special operator capable of testing the line and applying the howler, etc., the scheme can be provided for as shown

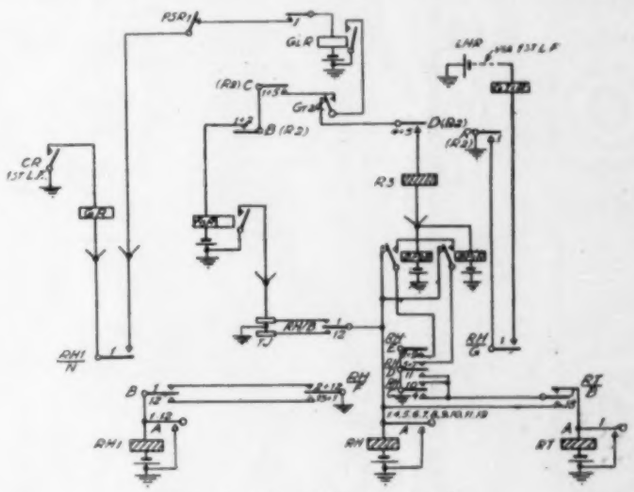


Fig. 5—Periodic Distribution of Calls.

in Fig. 4. Each connection circuit in the exchange has to be associated with a special jack and calling signal controlled by relays and keys. The operation is as follows:

(1) When a permanent calling signal is received, the semi-automatic operator throws the release key *RK*, and permanent signal key *PSK*, simultaneously, energizing *RR, PSR* and PSR_1.

(2) *RR* operates, releases the connection and restores the automatic circuits to normal.

(3) *PSR* and PSR_1 operate and lock up through PSR_1 and jack *PSJ*.

(4) Lamp *PSL* also glows.

(5) *PSR* also holds *COR* and *LHR*, thus providing a holding circuit for the 1st L-F.

(6) R_1R is disconnected at contacts of *PSR*, thus opening the meter circuit. The circuit of *GLR* is also broken at PSR_1 to prevent the connection circuit receiving another call.

(7) The special operator plugs in, tests the line and applies the howler if necessary. *PSL* and *PSR* are now disconnected, PSR_1 remains energized *viâ* the earth on the jack, and *COR* and *LHR* are held *viâ* earth on the sleeve of the testing plug.

(8) The operator now tests the line, applies the howler, and keeps the line under observation for 10 to 15 minutes.

The special operator will report faulty circuits to the test clerk, quoting the connection circuit number associated with the faulty lines to enable that officer to trace the subscriber's number concerned. In these cases

the testing plug will not be withdrawn until an advice is received from the test clerk.

When the plug is withdrawn, relays COR_1, LHR and PSR_1 are disconnected, thus releasing the first line finder and joining up the connection circuit for further traffic.

(9) It will be observed that the scheme necessitates holding the connection circuit and 1st line finder in order to ascertain if the fault is due to a slow answer, or a receiver off.

The principal requirement is that the glow shall be removed from the semi-automatic operator's position, and this result can be obtained by either of the following alternatives:—

(*a*) Semi-automatic operator to signal the test clerk and verbally report the connection circuit number.

(*b*) Semi-automatic operator to set up on the keyboard the connection circuit number to be displayed on a carriage call indicator in front of the test clerk.

In connection with these alternatives, the test clerk can trace the subscriber's number and connect the line at the main frame with a numbered jack and lamp circuit terminating on the exchange testing position. The permanent signal will thus be transferred to the testing operator for supervision as before.

It will be apparent that either alternative scheme will be more economical as regards plant, with the additional advantage that the connection circuit and first line finder will be released for traffic more rapidly.

CALLED SUBSCRIBER ENGAGED. FIGS. 2 AND 4.

When the final selector reaches an engaged subscriber's line, sequence switch R_1 is moved to position 9, and the following alternative schemes may be afforded:—

(*a*) A busy tone may be transmitted to the originated subscriber as an indication that the receiver should be restored, as is the case in full automatic exchanges and a busy flash signal to the semi-automatic operator *viâ* FL_2, C_9 of R_1 and lamp CS.

(*b*) If the traffic requirements stipulate that the originating subscriber shall be asked if he desires to be rung when the called subscriber is disengaged, as is customary in manual exchanges, it is desirable that facilities shall exist for transferring the subscriber to a special operator, in order that the semi-automatic operator's position may not be made busy to other calling subscribers, while attention is being given to service of this nature, which in a semi-automatic exchange would always involve making a ticket record, and sometimes frequent trials before the two subscribers could be connected.

For scheme (*b*), circuit arrangements can be afforded whereby in position C^9 of R_1, instead of flashing the calling supervisory lamp CS (see Fig 2), a special operator is signalled on a lamp and jack associated with the connection circuit. The special operator would answer with a connection circuit, terminating in a plug, and thereby control the connection with the first L.F. until the desired connection had been established. (Fig. 4.)

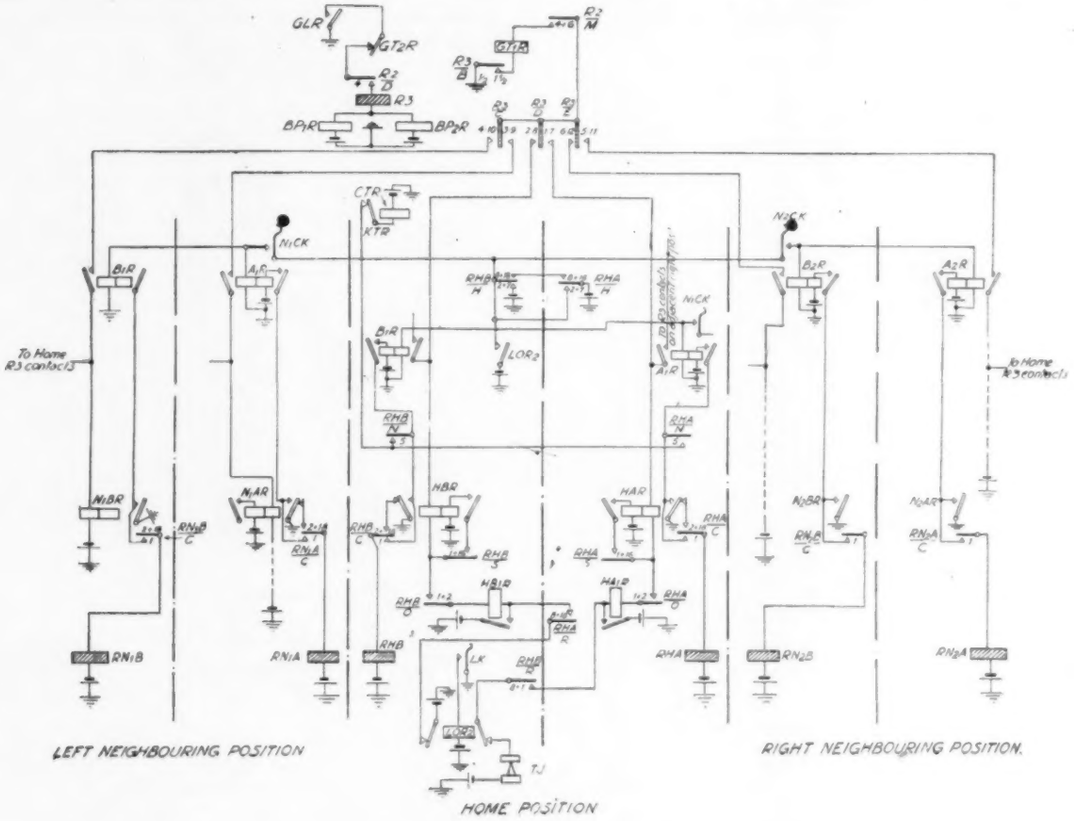


Fig. 6—Helping-Out Arrangement.

By operating testing key TK, relay BRR will operate if the originating subscriber is disengaged. Sequence switch R will now be energized and the connection circuit will perform similar functions to that on a semi-automatic position.

After depressing the number keys, the call will progress to the called subscriber in the usual manner, and if the line is disengaged the ringing will be applied and at the same time sequence switch R will move to position 12, thus completing the circuit of relay ARR to automatically ring the originating subscriber simultaneously. When the latter replies, RGR operates and energizes ROR, in order to disconnect the ringing circuit and associate the line with the connection circuit for conversation to proceed.

NO REPLY FROM CALLED SUBSCRIBER. FIGS 2 AND 4.

The continued glowing of ringing lamp *RL* indicates to the semi-automatic operator that the called subscriber has not answered.

(*a*) The operator may throw the listening key *LK* and inform the originating subscriber, and then release the connection in the ordinary manner, leaving the subscriber to originate the call later.

(*b*) If the traffic requirements stipulate that the originating subscriber shall be asked if he desires to be called when the number required can be obtained, as is customary in manual exchanges, it is desirable for the reasons referred to in the case of "Subscriber engaged" calls, that the subscriber shall be transferred to a special operator.

For scheme (*b*) in this case, the semi-automatic operator will need to throw the release key *RK* and a key performing similar functions to *PSK*, used in the case of lamp glow faults, in order to signal the operator on a lamp and jack associated with the connection circuit concerned.

The special operator would answer with a connection circuit terminating in a plug and proceed as for "subscriber engaged" calls. (Fig. 4.)

Of the alternative schemes (*a*) and (*b*), referred to for "no reply" calls and "number busy" calls, it will be seen that to provide for scheme (*b*) will involve expensive provision of plant, consisting of a lamp and jack for every semi-automatic connection circuit—and a number of connection circuits on the special position, with full supervisory facilities, registers and keyboard sender, etc.

Scheme (*b*) has been introduced in manual exchanges, with the object of earning more revenue. The statistics available show that in 95 per cent of the cases subscribers agree that these ineffective calls shall be completed for them; statistics also indicate that 94 per cent of the cases re-rung mature after three attempts.

In manual exchanges where additional plant is not required it may or may not be economical for the operators to endeavor to complete ineffective calls. In semi-automatic exchanges the introduction of this scheme would appear to be very uneconomical and the question arises whether statistics are available showing the percentage of ineffective calls which the subscribers themselves would attempt to complete without the special attention on the part of the operator, in order that the true value may be apportioned.

ARRANGEMENT FOR HOLDING SWITCHES. FIGS. 2 AND 4.

In all automatic systems it is very desirable to know the actual details of any difficulty which is experienced in order to be in a position to reproduce the trouble, or prove that all is correct; otherwise tests of an extensive character need to be carried out to locate the particular switch which fails to function properly, since it is impossible to ascertain which circuit combination out of a group of trunks was involved in the faulty connection. In the Western Electric Company's semi-automatic system the hold-over circuit arrangements provide means for the operator to trap the faulty switches as they come under notice.

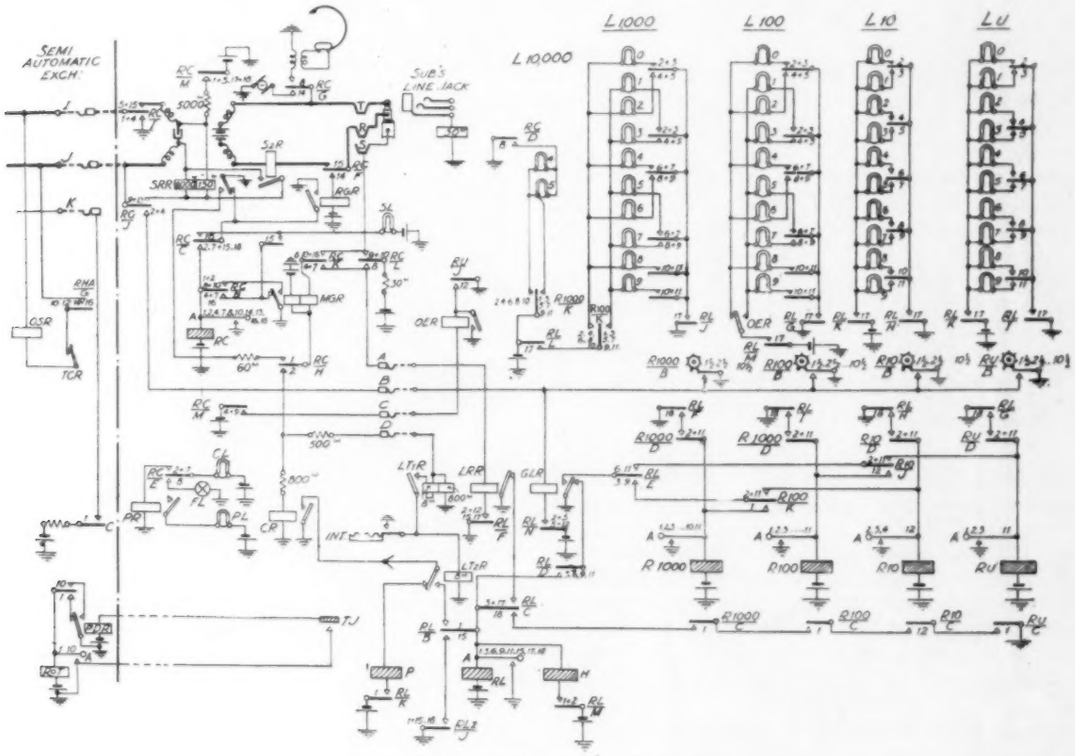


Fig. 7—Carriage Call Junction Working.

When an operator observes that a call does not progress, *i. e.*, the ringing lamp flickers continually or progresses incorrectly, *i. e.*, obtains wrong number, due to missing an impulse, a special circuit (Fig. 4) is provided on her position which enables the operator to

(*a*) Release the subscribers, associated with the faulty connection circuit.

(*b*) Place an engaged test on the chain of automatic switches concerned, so that the faulty switch or switches may be held and not used again.

(*c*) Signal the test clerk, on a lamp circuit associated with the connection circuit concerned.

The momentary depression of the common hold-over key *CHOK* and listening key *LK* of the connection circuit concerned completes the following circuits:—

(1) *HOR* operates and locks *via* lamp *HOL*, its 240ω winding contacts *MHR*, *M* of R_1, *RR*, and *R* of R_2. Lamp *HOL* glows in front of the test clerk.

(2) *HOR*, disconnects, R_1R and *COR*. *LHR* in the same circuit remains energized, from LT_2R, contacts LT_1R, 20ω winding of *LHR*, brush *H*, contacts PSR_2, and R_1R, *J* of R_1, S_1R to battery. This holds the 1st L.F. circuit.

(3) With *COR* disconnected, the *LR* is re-connected and the waiting subscribed is found by another 1st L.F.

(4) When R_1R is disconnected, although the connection circuit brushes are actually in contact with the subscriber's line terminals, no electrical circuit exists.

(5) S_1R remains operated and holds the connection circuit.

(6) *MHR* operates *via* contacts R_1R and *L* of R_1 and earth on connection circuit repeating coil and disconnects *HAR*, thus moving the register *RHA* to its home position *via* $\frac{RHA}{C}$ 2 + 18.

(7) *HOR* provides ground on its contacts to keep S_2R energized, which moves R_1 to 14, if not already in that position.

(8) The switches used for the faulty connection are thus held until the test clerk attends.

There are several variations in the circuit conditions, depending upon the stage the connection had reached when the operator completed the hold-over circuit.

After the defect is located, the test clerk asks for the connection circuit to be released. The operator then throws the release key *RK* and common release key *CRK* simultaneously, to release the connection in the usual manner.

These seems little doubt that these facilities will enable the extent of maintenance routine testing to be reduced considerably as compared with that necessary for full automatic working, and in addition the actual location of faults reported will occupy much less time, both conditions which must favorably affect the service rendered.

HELPING OUT ARRANGEMENTS. FIG. 6.

These arrangements provide facilities for team working. In manual C.B. exchanges, where the connecting circuits on the answering positions terminate on plugs and cords, team working depends entirely on the desire of the operators to assist the neighboring positions. In the Western Electric Company's semi-automatic exchange system the helping out arrangements automatically determine whether an operator is able to assist the neighboring positions.

It will be seen from Fig. 6 that each position is provided with two registers, *A* and *B;* the wiring of the *A* and *B* registers of the principal position only is shown in detail, and the wiring for the adjacent positions shows only the essential parts in connection with the helping out arrangements.

The *A* and *B* registers are each provided with two helping out relays, A_1R, A_2R, and B_1R and B_2R, respectively, with two coupling keps, N_1CK and N_2CK, associated with the above relays. The left neighboring position shows the circuit arrangement for the A_1R and B_1R relays, and the right neighboring position shows that for the A_2R and B_2R relays.

Taking any three positions as a group, the center will be principal position, the adjacent left the first assistant, and the adjacent right the second assistant.

If the completion of calls associated with connection circuits on the principal position is considered, with the coupling keys on the adjacent positions in their normal position, the two registers *A* and *B* on the home position only can be associated with the connection circuits.

With neighboring one coupling key N_1CK operated, the *A* and *B* registers and telephone circuit on the adjacent left position are available to deal with calls associated with the connection circuits on the principal position. With key N_2CK operated, the *A* and *B* registers and telephone circuits on the adjacent right position are available for a similar purpose. The operation is as follows:—

The R_3 sequence switch, in searching for a free register, rotates over six principal positions in the following order:

1st	*A*	Register of	Home or Principal	Position.		
2nd	*B*	"	"	"	"	"
3rd	*A*	"	" adjacent left	position.		
4th	*B*	"	"	"	"	"
5th	*A*	"	"	" right	"	
6th	*B*	"	"	" right	"	

Assuming that the home position *A* register is free, a circuit is closed from *D* of R_3, through *HAR*, O_1 of *RHA*, HA_1R, *R* of *RHB*, LOR_2 to battery on telephone jack *TJ*. If the *A* register is busy and *RHA* is in position 8, a similar circuit will be closed *via* D_2 of R_3 for the *B* register, through *HBR*, O_1 of *RHB*, HB_1R, *R* of *RHA*, LOR_2 to battery.

If both these registers are engaged and the helping out keys on the adjacent positions are thrown, relays A_1R, B_1R, A_2R and B_2R will be operated *via H* of *RHA* and *H* of *RHB*. This will close close circuits in turn from C_3 and 4 of R_3 for the *A* and *B* registers on the adjacent left positions, and from E_5 and C_6 of R_3 for the *A* and *B* registers on the adjacent right position, thus automatically associating the adjacent position telephone and register circuits to deal with calls which may arrive.

When an operator receives a momentary buzz in her telephone, as previously explained, the non-existence of a flashing calling lamp on her position is a guide to her that the call requiring attention is associated with the connection cirtcuits on one of the adjacent positions.

AUTOMATIC DISTRIBUTION OF CALLS TO OPERATORS. FIG. 5.

In all automatic exchanges, the subscribers are cross connected in groups, so that the busy hour originated traffic of each group is correspondingly equal to the number of outlets available for each group.

In the Western Electric Company's semi-automatic system, each sixty subscribers are found by a group of first line finders, which in turn are found by a group of second line finders and connection circuits associated with the operators' positions.

Only three groups of second line finders are provided, and the cabling arrangements between the second line finders and semi-automatic position connection circuits are so arranged that when any first line finder is found it is associated with a connection circuit on one of three adjacent semi-automatic positions.

The semi-automatic positions are thus divided into three divisions, each of the three adjacent positions belonging to a different division. This arrangement provides that any group of three adjacent operators may receive a call from any subscriber connected with the exchange and, as explained for the helping out arrangements, the operator at the center position of any group of three positions can, if desired, complete from her own keyboard all calls incoming to her own position, and also the two adjacent positions. Facilities are thus available for reducing the number of operators during any period of the day from the total number of positions

down to one operator, according to the traffic load to be carried.

In addition to these arrangements for automatically regulating the operators' loads, the circuit arrangements on each position provide that calls shall be distributed periodically to each position in such a manner that after the receipt of a call at any position, a second call may not arrive until approximately three or four seconds later, a third call in six or eight seconds later, and so on, *i. e.*, each operator receives calls on a time basis. The first call to be dealt with is notified by the calling lamp flashing; all other calls existing on the same position give a steady glow.

In order to affect this periodic distribution each operator's position is provided with three sequence switches, *RH*, RH_1 and *RT*, and in order that a subscriber's line may be picked up by the connecting circuits on a position, the position sequence switches *RH* and RH_1 must be in position 1 to complete the circuit for connection circuit group. Relay *GLR, test relays* GT_1R and GT_2R. When these relays are energized, the following operations take place:—

(1) Relay *FOR* operates *viâ B* and *C* of R_3, GT_2R and *GLR*, and moves sequence switch *RH* to position 4 *viâ* B_3 of *RH*.

(2) Timing sequence switch *RT* operated *viâ* B_1 of *RT* and C_4 of *RH*, and makes one complete revolution.

(3) When *RT* passes position 18, *RH* is energized and moves to 5.

(4) If R_3 is rotating for a free register, *RH* will remain in 5, as BP_1R and BP_2R will be energized; when free register found, these relays are disconnected and then *RH* moves to 10, *viâ* contacts BP_1R and D_5 of *RH*.

(5) *RT* is again energized *viâ* B_1 of *RT* and C_{10} of *RH*, and makes a second revolution. In position 18 of *RT*, *RH* is again operated and moves to 11—the circuit of *RT* is then again closed, and a third revolution is made. *RH* being moved to position 1, as position 18 of *RT* is passed.

(6) While *RH* is out of position 1, RH_1 is energized *viâ* B_1 of RH_1 and *F* of *RH*—and moves to 12. When *RH* passes from 13 to 1, RH_1 is energized *viâ* B_{12} of RH_1 and moves to 1—thus making the position free to accept further calls.

(7) One revolution of *RT* occupies 1.25 secs., therefore the three revolutions of *RT* which take place before *RH* and RH_1 can reach position 1, after once leaving it, keep the operators' position busy to all other subscribers for 3.75 secs.

(8) This period can be varied if desired by altering the switch positions on the timing switch *RT*, but a period of 4 seconds, approximately, is found to be convenient to enable the operator to answer a calling subscriber, and depress the keys, before another call can arrive.

(9) With the even operating arrangements provided for all classes of traffic on each of the semi-operators' positions, the general effect of this periodic distribution is that one call is connected to each of the positions, before any of the operators receive a second call, thus resulting in smooth operating conditions.

OUTGOING NON-FEE JUNCTION CALL—NO DELAY SERVICE. FIG. 7.

When a subscriber demands a number in a distant exchange, the semi-automatic operator repeats and then depresses an office button, followed by the numbers of the subscriber concerned, and so far as the semi-automatic operator is concerned the call proceeds as for a local call. At the distant exchange each incoming junction terminates in a plug, a calling lamp and a supervisory lamp; a number indicator is also provided on which the number to be connected is displayed. The simultaneous appearance of numbers on the indicator and a flashing calling lamp indicates to the B operator that the number shown is desired to be connected on the incoming junction plug associated with the flashing calling lamp. It will be seen from Fig. 7 that in order to transmit the subscriber's number from the semi-automatic operator's keyboard to the number indicator the position equipment at the distant exchange consists of four registers, two sequence switches and two line finders. The latter are required to temporarily connect the register equipment with any of the junctions on the position. Two sets of registers are provided and are wired so that they may be operated independently on two different connections, only one to be associated with the number indicator. This method of working is termed "carriage call" working.

With the operator's telephone plug in circuit at the distant exchange, the junctions are available to be picked up at the semi-automatic exchange, as the sequence switch *ROT* is thereby maintained in position 1.

Assume 44364 is depressed, the first digit representing the office button will select the level on the first group selector accommodating the junctions outgoing to the exchange concerned.

(1) An idle junction to the distant exchange is thus found, and the line *viâ* the group selector is made busy to all other calls under similar conditions as for local calls.

(2) The outstepping relay circuit is then associated with the line terminals *viâ* brushes *I* and *J*, thus completing a circuit at the distant exchange from battery *viâ* $\frac{RC_1}{M}$, 5000ω resistance calling relay *SRR*, *B* line, $\frac{RHA}{G}$, relay *OSR*, *A* line, to ground on $\frac{RC_1}{I}$ *SRR* operates.

(3) *MGR* is energized *viâ SRR*, and moves *RC* to position 2 *viâ* $\frac{RC_2}{B}$, *MGR* now disconnected. Calling lamp *CL* and pilot lamp *PL* glow *viâ* $\frac{RC_2}{E}$

(4) CR is energized *viâ* $\frac{RC_2}{H}$ and *MGR*, and line finder *P* of free register rotates to find the junction.

(5) When the junction circuit is found, test relays LT_1R, and then LT_2R, operate *viâ* brush *D* of line finder. This disconnects the driving magnet *P* and energizes holding magnet *H viâ* $\frac{RL_1}{M}$ and $\frac{RL_2}{B}$ LT_2R and *CR*—to hold the line finder on the junction circuit. *RL* is also energized in parallel with *H*, and moves to position 3.

(6) *MGR* also operates *viâ* 8ω winding of LT_1R and LT_2R, and *RC* moves to position 4, disconnecting battery from calling relay *SRR* at $\frac{RC_3}{M}$ and operating *LRR*.

(7) In position 2 and 3 of *RL* the fundamental circuit for the registers is completed from battery *viâ* $\frac{RL_3}{N}$, *GLR*, brush *B*, $\frac{RC}{J}$, *B* line, *OSR*, *A* line, to ground on $\frac{RC}{I}$; *OSR* and *GLR* operate.

(8) The circuit for R_{1000} is now completed *viâ* $\frac{R_{100}}{K_3}$, $\frac{RL}{E_3}$ and *GLR*—1000's register rotates from its home position 1. Between position 1 and 2, 2 and 3, etc., it places earth on its contact *B* and short circuits relay *OSR* of the originating automatic register circuit, thus energizing the train of counting relays in the manner previously described for a local call. For digit 4, R_{1000} must de-energize *OSR* five times to operate the last counting relay *TCR*, R_{1000} will thus be left in position 6—ready for lamp 4 to be displayed in the L_{1000} group of lamps.

(9) *OSR* is disconnected when the last connecting relay *TCR* operates, and the automatic register *RHA* moves to position 12 to count the 100's impulses.

(10) When *GLR* de-energizes after the completion of the 1000's impulses, *RL* is energized *viâ* $\frac{RL}{D_3}$ and moves to position 6. *GLR* and *OSR* are now again energized ready to count the 100's impulses. The circuit for R_{100} is completed *viâ* $\frac{L_{10}}{J_{10}}$ $\frac{RL}{E_6}$, and *GLR*. 100's register rotates from its home position 1. Between position 1 and 2, 2 and 3, etc., the ground on $\frac{R_{100}}{3}$ short circuits relay *OSR*, for digit 3, R_{100} will operate three times and be left in position 4 ready for lamp 3.

(11) Operation 9 is repeated and *RL* moves to 9 and *RHA* to 14, and the circuit for R_{10} is completed *viâ* $\frac{R_{100}}{K_2+11}$, $\frac{RL}{E_9}$ and *GLR*. 10's register rotates from its home position 12. Between 1 and 2, 2 and 3, etc., the earth on $\frac{R_{10}}{B}$ short circuits relay *OSR*. For digit 6, R_{10} must de-energize *OSR* seven times, and counting from its home position 12. K_{10} will be left in position 8 ready for lamp 6. Between 12 and 1, *OSR* is not short circuited as the ground is absent on $\frac{R_{10}}{B}$.

(12) Operation 9 is repeated and *RL* moves to 11 and *RHA* to 16, and the circuit for *RU* is completed *viâ* $\frac{R_{10}}{J_2+11}$, $\frac{RL}{E_{11}}$ and *GLR*. *U*'s register rotates from its home position 1. Between 1 and 2, 2 and 3, etc., the ground on $\frac{RU}{B}$ short circuits relay *OSR*. For digit 4, of an odd hundred, as in this case, *RU* must de-energize *OSR* 15 times, *RU* will thus be left in position 6 ready for lamp 4. *OSR* is short circuited ten times from 1 to 12, and five times from 1 to 6, as the ground on $\frac{RU}{B}$ is absent between positions 11 and 1. In position $\frac{J}{12}$ of *RU*, relay *OER* operates and locks *viâ* $\frac{RC}{M}$, this completes the circuit *viâ* $\frac{RL}{M}$, for battery serving odd hundreds lamps. $\frac{R_{100}}{K}$ and $\frac{R_{1000}}{K}$, both in an even position serve a similar function for an even thousand and even ten thousand lamp respectively, *i. e.*, if desired the figure 44364 can be transmitted to the lamps—or 54364—or any number in the series from 40000 to 59999. The office button can therefore be used for selecting the line to the distant exchange, and displaying the odd or even ten thousand digit before the operator. This is possible on account of the Western Electric Company's scheme of numbering and use of sequence switches.

(13) Operation 9 is repeated and *RL* moves to position 15; if the 2nd register RL_2 is not connected with the lamps, *RL* is again operated *viâ* $\frac{RL}{B_{15}}$ and $\frac{RL_2}{J}$ and *RL* moves to position 17. In this position the circuit for each lamp is completed and the called subscriber's number is displayed before the operator.

When *RL* left position 12, relay *MGR* de-energizes, thus operating *RC*, which moves from position 4 to 7 to disconnect the carriage call circuit from the junction at contacts *I* and *J* of *RC*.

The calling relay *SRR* is now bridged across the junction and operates from the connection circuit in the automatic exchange.

In position 15 of *RL*, *MGR* is operated before *RC* reaches position 7, and again de-energized after *RL* passes position 15. *RC* now moves to position 8, in which position *LRR* remains energized from battery *viâ* L_8 *of RC*.

In position E_8 *of RC*, the calling lamp *CL* flashes simultaneously with the glowing numbers on the carriage call indicator.

The operator picks up the plug associated with the flashing lamp, tests the number in the usual way and inserts in the multiple jack. *MGR* operates and moves *RC* to position 14; calling lamp *CL* is now disconnected. *LRR* is also de-energized to move *RL* to position 18 *viâ* contact *C* of *RL*. The number lamps are now disconnected and their respective registers are restored to normal *viâ* position 18 of *RL*.

RL returns to 1 *viâ* C_{18} of *RL* and the home position of each register in series, and is now ready for another call. In position 14 of *RC* the called subscriber is automatically rung *viâ* F_{14} and M_{14}.

When the subscriber replies, trip relay *RGR* operates and moves *RC* to 15. Supervisory relay S_2R_1 is now energized *viâ* *G* and *G* contacts, thus short-circuiting the high resistance in *SRR* circuit, which enables the supervisory relay in the automatic exchange to operate in order to move the switches to the talking position and afford the necessary supervision to the semi-automatic exchange operator.

After conversation is completed and the called subscriber restores his telephone, the supervisory relay in the automatic exchange is de-energized; the semi-automatic operator releases in the usual manner, thus moving the automatic switches and disconnecting the circuit of *SRR* to move *RC* to position 16. The B operator's supervisory lamp *SL* now glows as an indication to withdraw the plug. *MGR* then de-energizes and *RC* moves to position 1.

Should another call arrive during the period of the disconnection of the junction circuit in the automatic exchange and the withdrawal of the plug by the B operator, the new call will remain waiting until the latter disconnects and again completes the circuit of the calling relay *SRR viâ* 1 of *RC*.

TABLE I. SUBSCRIBERS' NUMBERING SCHEME FOR 100,000 LINE SYSTEM.

Level No.	Lines Associated with 1st Group Selector	Subscribers' Numbers Associated with Level of Preceding Selector. 2nd Group Selector.	3rd Group Selector.	Final Selector— Even 100's.	Final Selector— Odd 100's.
1	00000—19999	00000—01999	0000—0199	000—009	100—119
2	Other Exchanges	10000—11999	1000—1199	010—019	110—119
3	20000—39999	02000—03999	0200—0399	020—029	120—129
4	Other Exchanges	12000—13999	1200—1399	030—039	130—139
5	40000—59999	04000—05999	0400—0599	040—049	140—149
6	Test	14000—15999	1400—1599	050—059	150—159
7	60000—79999	06000—07999	0600—0799	060—069	160—169
8	Enquiry	16000—17999	1600—1799	070—079	170—179
9	80000—99999	08000—09999	0800—0999	080—089	180—189
10	Toll	18000—19999	1800—1999	090—099	190—199

N. B.—Similar groups of numbers (with a different initial digit to those shewn for level 1 under 2nd Group Selector, 3rd Group Selector and Final Selector are associated with the remaining levels.

OUTGOING TOLL AND SHORT DISTANCE TRUNK CALLS. NO DELAY SERVICE. FIG. 7.

This class of call is dealt with similarly to an exchange trunk call, but the semi-automatic operator does not repeat the exchange and number asked for by the subscriber.

The carriage call equipment in this case is fitted in the semi-automatic exchange before a special operator, the incoming trunks to be associated with the number indicator terminate on jacks and lamps, and the trunks to the distant exchanges are connected to standard outgoing trunk multiple jacks.

To those exchanges having direct trunks outgoing from the semi-automatic exchange the carriage call indicator shows the code of the exchange required instead of the ten thousand digit, together with the called subscriber's number. The special operator inserts the answering plug into the jacks of the incoming trunk and asks the originating subscriber for his number, at the same time repeating the exchange and number which is shown on the number indicator. A ticket record will then be made and, if possible, the call at once completed.

For through junction calls a lamp in the ten thousands series will be arranged to flash, followed by the subscriber's number. In this case the special operator will ask the originating subscriber for the name of the distant exchange, as well as his own number.

This transfer method of working is designed to prevent the semi-automatic operator dealing with difficult calls and making ticket records, etc., and the originating subscriber is unaware that a second operator is dealing with the call.

OUTGOING LONG DISTANCE TRUNK CALLS DELAY SERVICE.

The originating subscriber asks for trunks as in C.B. manual exchanges, and the semi-automatic operator de-

presses a single special service button which transfers the subscriber to the trunk exchange operator for the call to be recorded and completed later in the usual manner. The call is not registered when released by the semi-automatic operator.

OUTGOING CALLS TO INQUIRY OPERATOR AND TEST CLERK.

The semi-automatic operator depresses one of the special service single buttons and transfers the calls, When released, registration does not take place.

OUTGOING CALLS TO DEAD LEVELS AND DEAD NUMBERS.

These calls are received on the inquiry operators' positions and are not registered when released.

INCOMING TRUNK CALLS.

The resistance of the majority of trunk circuits will be below 750ω, in which case it will be possible to arrange for the distant exchange operator to dial and obtain the required number direct from her position. Although this will involve equipping dials at the distant exchanges and the provision of special selectors at the semi-automatic exchange, it will be more economical than obtaining the number *viâ* a "B" operator in the semi-automatic exchange.

In those cases where "dialling-in" direct cannot be arranged for, the junctions can terminate as jack-ended junctions in the semi-automatic exchanges, the operator at the latter completing the calls by dialing *viâ* outgoing junctions to selectors in the semi-automatic exchange.

Higher Rates Needed

"It has been necessary to increase rates in several exchanges during the year and following our regular parctice of trying to make every exchange earn a fair return on its investment it will be necessary to make a great many increases in the near future," says the annual report of the Citizens Telephone Company, presented at the annual meeting of the stockholders September 11.

Continuing, the report says: "The rates in some exchanges are so low that it never has been possible to earn a fair return and with the increased and increasing cost of all material advances must be made if we are to continue giving service in these exchanges."

The earnings of the company from exchange and toll lines were $972,164, an increase of $77,996 over the preceding year; from interest and other sources, $20,065, a decrease of $11,394; total, $992,229, an increase of $66,601. The operating and general expenses, including $58,573 taxes, were $488,250, an increase of $35,940; net earnings, $503,978, an increase of $30,660; interest, amortization and depreciation charges, $217,786, an increase of $22,807; dividends paid, $231,104; sinking fund, $5,718, and balance carried to surplus $49,368; an increase in the balance of $7,853 as compared with the preceding year.

The balance sheet shows a total of $5,244,380 assets, an increase of $426,898 over last year. The largest items in the assets are exchange and toll line investment, $4,375,890, an increase of $258,342; stocks and bonds in other companies, $673,347, an increase of $140,128, and bills and accounts receivable, $56,471. The liabilities show an increase of $272,500 in bonds outstanding, $60,000 in bills payable and $50,421 in accounts payable. The surplus is shown as $127,508, an increase of $11,655.

Reviewing the work of the year the annual report shows that the company has 39,117 subscribers, not including the "farmer lines," an increase of 3,088, the largest increase for a single year since 1906. The largest increase was in the Lansing exchange, 1,305, and the next largest in Grand Rapids, 915. The plant investment in Grand Rapids was increased $80,431 and in Lansing $109,913; the automatic system was put in at Hastings and much development work was done at Battle Creek, Jackson and Marshall. The Grand Rapids expenditures included 800 automatic switches, 59,385 feet of aerial cable, two automobile trucks and three roadsters. Approximately 31,700 miles of wire in cables was installed during the year over the system. On account of the extremely high cost of copper toll line extensions have been kept down, but facilities have been increased by the installation of "phantom circuits," making two circuits between two points serve the purpose of three circuits. Automatic calling dials have been installed at Rockford, Middleville, Hastings and other nearby points.

During the year the company's old 6 per cent bonds were refunded at 5 per cent and $272,500 additional bonds have been issued, making the total outstanding $800,000, with $2,130,000 in the treasury and $70,000 deposited as surety for bonds of subsidiary companies. The depreciation reserve for the year was $175,623, or 4 per cent of the exchange and toll line investment, and of this $34,177 remains still available. The company has 3,070 stockholders, of whom 1,405 are in Grand Rapids, 1,137 in Michigan outside of Grand Rapids, 509 in forty different states and nineteen in six foreign countries.

Increasing Facilities in Michigan

The Michigan State Telephone Company, in anticipation of a big increase in long distance business between Battle Creek and other large cities in Michigan, following the mobilization of the national army, is making additions to its toll line equipment out of that city.

The total cost of these extensions is estimated at about $175,000. The telephone company is employing men wherever it can get them placing them at work on the new construction work.

Three of the new circuits will be through lines, one for Battle Creek to Detroit business and two for Battle Creek to Jackson calls. Besides these three lines three new lines are being built between Battle Creek and Jackson, two between Ann Arbor and Battle Creek and two between Battle Creek and Lansing.

During the past summer two circuits have been built between Niles and Benton Harbor, one between Niles and Buchanan, one between Niles and South Bend and two between Niles and Chicago.

The Niles office is receiving new equipment which when installed will cost $3,000. One new toll switchboard and one new local board are being built.

Directories, One Cent

When the new directories for the Pioneer Telephone Company at Drumright, Ga., were published and made ready for distribution, the company hired Claude Duff, a small boy, to deliver them, offering him a penny for each directory he delivered.

Shortly after noon the boy returned to the office, laid down 62 pennies and an armful of directories, saying that was all the directories he could deliver. It developed that the lad had been charging each of the places to whom he delivered a book a penny, and if they refused to pay he would not leave the directory.

The company issued a statement that the pennies were in the telephone office and if anyone wanted their penny back they could get it by calling. Those uncalled for were turned over to the little boy.

Samuel Hill Retains Holdings

To disprove the persistent rumors that have recently been in circulation to the effect that Samuel Hill, principal owner of the Home Telephone Company of Portland, Ore., had sold out his holdings of stocks and bonds, J. C. Potter, auditor of the company and Mr. Hill's personal representative in Portland, placed these securities in the hands of R. S. Howard, assistant cashier of the Ladd & Tilton bank.

Apparently the story of Mr. Hill's withdrawal from the company was concocted with malicious intent by interests opposed to the Home company organization, Mr. Howard said. That they were without the slightest basis in fact was shown by Mr. Howard. All records of stock and bond transactions are in his hands, as are Mr. Hill's securities, still in his name.

Mr. Howard is prepared to show to those interested in the matter that no transfer has been made.

The common stock issue of the Home Telephone Company is for $3,000,000. Mr. Hill owns over 50 per cent, or the controlling interest in this. The outstanding bonds of the company now amount to $2,750,000, and of these a large amount is also owned by Mr. Hill.

Shortly after the telephone company went into the hands of a receiver, a committee of Portland bondholders was organized. This committee has made a careful investigation of conditions, and a report has been prepared and is being printed.

One of the committee members said the report would be very favorable and the actual figures to be shown encouraging. The company's earnings are more than paying the operating expenses each month. A few thousand more telephones in Portland, the report will assert, would put the company in a position to meet its funded indebtedness, as represented by bond interest obligations.

Texas Telephone Co. Equips Camp

Of all the lines of activity that were called upon to extend themselves that Waco, Texas, might prove equal to the tremendous strains necessary to meet the United States government in its deterimnation to build in a night a training camp for soldiers, no one organization has more right to be proud than the Texas Telephone Company. Every officer of that company, every foreman of construction, every member of the construction crews, the supply, equipment and traffic departments have worked as they never worked before, and the results show that they have builded to the best end. The necessity of communication is the first necessity of modern life and the Texas Telephone Company provided that for Camp MacArthur.

At a cost of from forty to fifty thousand dollars, there has been built at Camp MacArthur a telephone plant that would be adequate for Belton or Mart, two of the busiest towns in Texas for their size. This big expense has been necessary because all material, equipment and construction must conform to United States Government specifications. The construction is of the highest class, cables and not open wire. Sufficient trunks were erected to meet all requirements now and the demands of the future. Over one thousand miles of wire were required, and now there is a plant that by the simple addition of instruments where needed a military camp of 100,000 men can be provided with communication.

From July 20, 1917, when the "first on the ground for the construction of Camp MacArthur" sign of the Texas Telephone Company went up, to this day, this company has had its crews and supervising chiefs at the absolute disposal of the Fred A. Jones Construction Company, and of both the camp quartermaster and Major Hansen, of the government's constructing quartermaster department. When a hurry-up message for materials or anything else was needed to be shot to destination, the telephone was at their hand for their uses. Materials were assembled from far points, and the company's resources were found to be so organized that everything was ready as its need came. This was accomplished at an expense that few can realize and with little promise of returns commensurate to the expense.

Fifty-seven telephones are installed at the base hospital, one for each structure. When all of the military units are there, there will be an instrument for each company, each troop, each battery, each corps. Several telephones will be placed, as many are now, at each regimental and brigade headquarters, and at division headquarters, each officer will have his own telephone instrument. Arrangements are made for fifty telephones in various parts of the camp to be designated by the chief signal officer, and these instruments will carry a nickel-service to any part of the camp or city. This service will be for the public and for the soldiers and to add to the convenience of everybody. At the same time this service also insures privacy of communication.

It is because of the great territory covered by Camp MacArthur and the fact that all construction and equipment necessarily complied with government specifications that the cost of this plant is so high.

Duty to Discover Uninsulated Wire

A telephone lineman working on a pole adjacent to that of an electric company was not required to discover the fact that high-tension electric wires were uninsulated, where he had no knowledge of their dangerous character, according to the Court of Civic Appeals of Texas in the case of the City of Weatherford Water, Light & Ice Company versus Veit (196 S. W. 986). A telephone lineman could assume that his employer had provided him with a safe place to work and also that defendant's high-voltage wires were fixed to its cross-bars in the usual and customary manner to indicate the dangerous or the harmless nature of the wires. Knowledge of danger from high-tension wires in close proximity to the telephone company where such condition had long continued, and because as matter of law it was the telephone company's duty to know of such condition.

Raise Wires for Ranchers' Convenience

In a statement issued by the Mountain States Telephone Company, ranchers are informed that if they will give reasonable notice the company will send linemen to cut and rapair wires where such action is necessary in order to move hay stackers. Although the law of Idaho state provide severe penalties for interfering with telephone or power circuits, many ranchers have, nevertheless, played havoc with the wires in moving their haying machinery. As a result telephone service has often been seriously interfered with. In calling for the co-operation of the farmers and offering to bear the expense of taking down its lines whenever found necessary it is believed the long-standing controversy, which has been renewed each fall, will be permanently and satisfactorily disposed of.

Public Utility Commission News

Reports Concerning the Activities of State Regulating Bodies in the Telephone Field

Ohio

ATTACK by John C. Rogers and the Citizens Committee of Cincinnati against the Cincinnati Suburban Telephone Company's proposal to issue bonds for improvements, failed before the Utilities Commission at Columbus.

Rogers contended the company has sufficient surplus for improvements, and that proposed additional stock issue merely is an extra dividend for stockholders.

He demanded a valuation of the company's property, and investigation of its rates, which, he charged, are excessive. He also asked that part of the company's excess earnings be applied to reduction of rates.

The commission ruled the company's plans come under a legitimate capital arrangement, but that if Rogers desires to attack its surplus and dividend funds he must do so by attacking the company's rates.

Hearing in Supreme court of the case of the Lima Telephone Company against the Public Utilities Commission of Ohio has been set for Wednesday, October 10. Lawyers in the case are: Attorney-General Joseph McGhee and C. A. Radcliffe, of Columbus; former City Solicitor Melvin Light, and John W. Roby, attorney for Lima Chamber of Commerce.

Attorneys for the plaintiff are: Cable & Cable, and Wheeler and Bentley, of Lima. The action has been pending for some time and is the result of trouble which ensued when the Lima Telephone Company raised its rates, which it claimed was necessary, after improvements were made on the local plant.

The city and Chamber of Commerce took the matter up with the Public Utilities commission to keep the rate down. The case was finally taken to Supreme court.

The Board of Trade may add its protest to that of farmers in the vicinity of Wooster who are circulating petitions protesting against the raise in rates made by the M. W. & O. Telephone Company effective September first.

Although proper notice of the proposed change was made, there was no hint of protest anywhere until the first bills for the increased price were mailed to subscribers September 1, payable before September 10.

Several petitions are in circulation in rural districts, it was reported. Judge C. A. Weiser, president of the Board of Trade, delved into laws governing the conduct of public utilities commission, and stated it was altogether likely that the Board of Trade would send a protest to the commission at Columbus, and ask for a hearing.

The M. W. & O. company is going ahead with the work of installing conduits in Wooster's business section. The new exchange will likely be installed during the winter months. With this improvement, the company expects to be able to give unexcelled service.

The matter of rates charged to Wayne county, it was believed will be settled without serious difficulty. The company will class telephones at the childrens' home, county jail and infirmary as residence telephones, thus materially reducing the rate. It will cut the infirmary rate to $3.25.

It was stated that there was much doubt whether the public utilities commissions will consider protest propositions at this late date, the company having given formal notice of the proposed increase. The change was heralded in page advertisements in newspapers.

Before the rates went into effect officers of the telephone company explained that they were entitled to an increase, because of additional service offered now. The company has more than 2800 telephones in service on Wooster exchange and business men under the new rate pay $3 per month to talk to these people, where they paid $2.50 to talk to half this number of subscribers a few years ago.

Alabama

Birmingham's telephone rate case, involving an appeal to the Public Service Commission for reductions in the rates and charges of the Southern Bell Telephone Company for service at that point, will come before the commission at Birmingham November 13. Announcement was made that this date has been agreed upon by attorneys for the city and company.

During the hearing the commission will be shown the Birmingham plant. The first hearing consumed a greater part of a month, and it is probable the session in Birmingham will consume several days as the telephone company is making the case thorough in the belief that the information will be valuable in other hearings.

Illinois

Telephone rates will be raised in Stephenson county if the State Public Utilities Commission grants the request of the Stephenson County Telephone Company which has been filed with the commission. The petition asks that the company be given the right to increase the rates on all classes of service twenty-five cents per month per telephone. However, this increase will be given as a discount if the rental is paid on or before the fifteenth day of the month. This means that if patrons pay their telephone rental on or before the 15th of the month the rates will remain the same but those who do not pay within that time will be charged an extra twenty-five cents.

The People's Telephone Company of Mercer county has filed a petition with the State Public Utilities Commission asking for authority to raise its rates for telephone service in Aledo.

The Montgomery county Telephone and Telegraph Company anounces the new schedule of rates which becomes effective on October 1, and which apply to Hillsboro, Schram City, Taylor Springs and surrounding country served from the Hillsboro exchange.

This change was made under an order from the State Board of Public Utilities and the increase was found to be necessary owing to the tremendous advance in everything, and especially in copper, wire,

lead, rubber, poles and hundreds of other things used in conducting an up-to-date telephone exchange.

This telephone company has recently installed a new system which gives better service than the old system and this has forced it to increase rates in the same proportion to the increase in operating expenses.

The new rates are as follows: If not paid by the 15th of each month, a reduction of 25 cents is given on each charge; if the bill is paid by the 15th of the month, except on the 75 cent charge made for extension telephone business or residence. This charge remains the same, likewise the 50 cent charge for extension telephone, business or residence without bells.

Business, individual line	$3.00
Business, two party	2.75
Business, four party	2.25
Residence, individual line	2.20
Residence, two party	1.75
Residence, four party	1.50
Extension telephone, business or residence	.75
Extension telephone, business or residence (without bells)	.50
Extension bells, business or residence	.25
Extra listing on business telephone	1.25
Extra listing on residence telephone	.75
Rural telephone, party line, metallic	1.75
Rural telephones, party line grounded	1.25

Massachusetts

The hearing by the Public Service Commission on the proposition of the New England Telephone and Telegraph Company to restrict new telephone installations came to an end when the commission took the matter under advisement.

One reason for the sudden ending of the hearing was the decision of W. W. Clarke, attorney for the International Brotherhood of Electrical Workers, who was expected to make a strong case in remonstrance, that it was unnecessary as the Telephone Company had "utterly failed to establish its case."

Whitfield Tuck of Winchester declared that Theodore N. Vail, president of the American Telephone and Telegraph Company, wanted Government ownership of the service in order to avoid a possible 80-per cent excess profit tax.

Commissioner Eastman tried to find out whether subsidiaries of the Western Electric Company are working on profitable war contracts, but he learned nothing definite from Philip L. Spaulding, president of the New England Company.

Counsel M. B. Jones for the company said that as regards materials the company is even with the game, but that the indefinite installation of unnecessary telephones would exhaust the present reserve capacity. This, he said, the company might not be able to renew in the future, and so might have then to refuse really necessary service, unless it went slow now.

He claimed that government work made a considerable addition to the company's normal work and took much of the time of skilled employes and that materials were obtained only with great difficulty. He said there was no consideration of profit in the proposed restriction.

He read quotations from an editorial in the Boston *Globe*, August 18, as a fair statement of the situation and he said that the company would be glad to confer with the Public Service Commission with a view to formulating a more satisfactory restriction program and to agree on the best way of carrying it out.

A memorandum was issued September 21, by the Public Service Commission concerning the attitude of the New England Telephone and Telegraph Company "to avoid new construction not directly associated with the war." The commission finds that such a policy "is not as yet justified," and adds that the company ought not, "for the present at least, go farther by attempting direct interference with the discretion of the individual." In the commission's memorandum is told how reports reached the commission of the company's proposed action, how a hearing was given and what conclusion has been reached by the commission.

The report points out that this restriction on new business, ascribed to war needs, was practically confined to the New England company. No evidence was offered that any other operating company had adopted a similar policy. It also appears, says the memorandum, that the Western Electric Company (the supplying company) has not warned the New England company of any impending shortage of supplies.

So far as the policy itself is concerned, it would have been perfectly consistent with the public interest, and desirable, for the company to have circularized its subscribers, or to have issued statements to the press, setting forth the need for conservation of resources and strict individual economy in the present emergency and strongly urging the public to refrain from seeking additional and unnecessary telephone facilities. The commission, indeed, would very gladly have cooperated in such a movement.

The policy actually adopted, however, goes beyond this and amounts to an attempt to determine for the individual what his course should be. Of necessity, it involves an examination into the affairs of each applicant for service—an examination made in the first instance by subordinates—for the purpose of determining whether or not reasonable necessity exists for the application.

The instructions laid down go so far also as practically to deny reasonable necessity for any new residential telephone, except in case of sickness. It is true that war conditions frequently require an exercise of authority which would not be acceptable in times of peace, but this principle is capable of abuse and ought not to be applied too readily to the management of private corporations.

In this case, the new policy has so many possibilities of uninformed, unfair or discriminatory treatment and involves such an invasion of the privacy of the individual that it ought not to be permitted, in the judgement of the commission, until the feasibility of less stringent expedients has been tested and its necessity has been better demonstrated.

Indeed, we are inclined to believe that such a policy ought not to be adopted until it has been directly advised by some central National authority representing and acting in the public interest, nor until it is made to apply not solely in certain New England States, but uniformly throughout the entire country.

The company has referred to restriction of railroad passenger service as an analogy, but this reduction was made primarily to assist the roads to meet known and positive needs of the freight service, and no similar situation exists in the present instance.

After all, the amount of conservation of basic materials and of other wealth which can be effected by limiting telephone service is relatively insignificant. Infinitely greater opportunities exist which relate to mere luxuries of living. The commission, therefore, expresses the opinion that the policy adopted by the company is not as yet justified.

Authority has been given the New England Telephone and Telepgraph Company to issue $5,432 shares of common stock.

California

The Pacific Telephone and Telegraph has filed with the Railroad Commission an application for authority to exercise the options given it by the United States Long Distance Telephone and Telegraph Company to purchase, before October 21 next, trust certificates at $60 a share, representing preferred capital

stock of the latter company of the par value of $448,000, and for authority to purchase, upon the same terms, trust certificates, representing the remainder, $52,000, of the preferred capital stock. The application says that the United States Company has an authorized capital stock issue of $3,000,000, $500,000 of which is preferred, and $2,500,000 of which is common, and that all of the capital stock is held by voting trustees. The Pacific Company wants to buy all the certificates of the voting trustees, representing the $500,000 preferred stock, if they can be obtained for $60 a share.

Indiana

The hearing of the petition of the Gaston Home Telephone Company, asking for permission to raise rates, was held at Gaston before E. J. Edwards of the commission. The company showed it had been in business nine years and had paid 8 per cent dividends each year with the exception of the first year, when the dividend was 5 per cent. The company seeks to raise the rate from $1, $1.50 and $2 a month to $1.25, $1.75 and $2.25.

Through Attorney D. F. Brooks, the North Manchester Telephone Company has filed a petition against the Public Service Commission in the Wabash circuit court. The plaintiff avers that the Eel River Telephone Company, a competitor, is engaged in business in that district and that the regular subscribers pay a flat monthly payment and are allowed to talk to South Whitley without additional charges to the monthly rate.

The plaintiff further avers, that the Public Service Commission issued an order on August 28, 1917, that a schedule of rates was to be filed before September 15, 1917, the same to provide for a 10c 3 minute rate and 3 cents for all additional minutes. The plaintiff avers that the order is unlawful.

The North Manchester Telephone Company asks that such order be reviewed and that same be reversed and that the commission be enjoined from enforcing the same.

A petition to raise telephone rates has been filed with the Public Service Commission by the College Corner Telephone Company of College Corner, O. The company serves townships in Union and Franklin counties, Indiana. It seeks to increase the residence rates from $1.25 to $1.50 and make a few other slight changes.

Michigan

In petitioning the Grand Traverse circuit court to stop the Citizens Telephone Company from raising its rates in Traverse City, the city authorities in that city have started a legal fight which may decide a much mooted question in Michigan affairs—whether the railroad commission has the right to permit of increased rates by a public utility where the rate is fixed by a city charter.

Years ago the telephone company made a contract with Traverse City not to put rates above a certain figure. Last spring it petitioned council for a change and failed. At the same time it asked the railroad commission for permission to raise the rate, as the state law declares. The commission granted the raise and now the city is going to the courts with the matter.

The railroad commission, to start its defense has set up that the Grand Traverse county circuit has no jurisdiction, inasmuch as the legislature has decreed that all suits of appeal from railroad commission orders must be filed in Ingham county circuit. Even if suit is brought here, the state will fight to the end, and a supreme court decision is certain.

An application is made by the United Home Telephone Company of Muskegon for permission to increase its rates in Coopersville.

Minnesota

The application of the Northwestern Telephone Exchange Company for permission to purchase the telephone property of the Dakota Central Telephone Company located in the state of Minnesota was duly heard on August 21.

The Dakota Central Company owns and operates eighty (80) local exchanges and 5,000 miles of toll lines in South Dakota, with one exchange at Russell, Minnesota, and certain of its toll lines extending to points in Minnesota, where they connect with exchanges and toll lines of the Northwestern and other companies.

The petitioner seeks authority to purchase all of the property of the Dakota Central Telephone Company located in the state of Minnesota, a more particular description of which property is as follows:

That telephone line running from Gary, South Dakota, to Canby, Minnesota, a distance of fourteen and six-tenths (14.6) miles.

That telephone line extending from Marshall, Minnesota, to the southwest corner of Section 30, Township 110, Range 43, of Lincoln County, Minnesota, being a point on the state line between Minnesota and South Dakota, which line extends through Marshall, Lynd, Russell, Tyler and Lake Benton, in the state of Minnesota, a distance of forty-seven and five-tenths (47.5) miles.

That telephone line extending from Lynd to the intersection of what is known as the Marshall-Volga line, a distance of approximately one-half (½) miles.

That telephone line extending from Verdi to intersection with the Marshall-Volga line, a distance of four (4) miles.

That telephone line extending from Arco to Tyler, a distance of nine and five-tenths (9.5) miles.

That telephone line extending from Pipestone to Tyler, a distance of thirty-eight (38) miles, which said line extends through Pipestone, Woodstock, Holland, Florence and Tyler.

That telephone line extending from Pipestone to Heron Lake, a distance of approximately sixty-three (63) miles, passing through Pipestone, Woodstock, Lake Wilson, Chandler, Hadley, Slayton, Iona, Fulda, Lime Creek, Dundee, Kinbrae and Heron Lake.

That telephone line extending from Wheaton to White Rock, a distance of twelve and one-half (12½) miles.

That telephone line extending from Pipestone to the South Dakota state line, a distance of six and three-tenths (6.3) miles.

That telephone line extending from Marietta to the South Dakota state line, a distance of two and eighty-three hundredths (2.83) miles.

That local telephone exchange at Russell, Minnesota, having a Western Electric type switchboard of ultimate capacity of one hundred five (105) lines and now serving sixty-six (66) subscribers.

The lines involved in this transaction serve the border of the Dakota Central territory and because of the distance from headquarters and being surrounded by lines of the Northwestern Company have been unprofitable. They are twenty years old, and because they are not profitable, have been allowed to become badly depreciated. The Northwestern Company has no toll lines paralleling or operating in competition with these lines and there is no competing exchange in Russell. Negotiations for the transfer of this property have covered a period of five years and the sale was sanctioned at a meeting of the directors of the Dakota Central Telephone Company held August 10, 1917. The price agreed upon for all of the property above referred to by the parties interested, is $20,500.

The petitioner desires to purchase the property for the reason that it lies in a portion of the state through which the Northwestern Company has toll circuits for the handling of local and through business, to which additional facilities should be provided and extensions made to properly take care of the toll bus-

iness in the territory served by the lines in question and provide secondary routings for through business between the commercial centers of southwestern Minnesota and South Dakota. The extensions have not been made for the reason that it would have been necessary to parallel the lines of the Dakota Central Company, which was considered undesirable. The lines of the Dakota Central Company described are either grounded iron circuits or metallic copper and iron circuits in poor condition and inadequate even for the handling of local toll service on a satisfactory basis, and more so, for the handling of long haul through business.

The Northwestern Company proposes immediately to make such repairs as are necessary to place the lines in good serviceable condition and will cause such construction to provide the extensions and additional facilities referred to for the secondary routing and the improvement of the local toll service as soon as reasonably consistent. The acquisition of this property by the Northwestern Company will result in some improvement in the service between nearby points and a material improvement in the service to the more distant localities. This transaction will in no way effect the toll rates now in effect or the local exchange rates at Russell, Minnesota.

It is therefore ordered, that the Northwestern Telephone Exchange Company be permitted to purchase from the Dakota Central Telephone Company the toll lines of that company previously described in this order and the local telephone exchange located at Rusell, Minnesota.

The application of the Zumbrota Telephone Company for an increase in certain of its exchange rates at Zumbrota, Minnesota, was heard at Zumbrota by Supervisor of Telephones J. W. Howatt.

The Zumbrota Telephone Company operates an exchange at Zumbrota. It has 62 business, 199 residence and 231 rural telephone subscribers. The Comercial Club petitioned for improved twenty-four hour service, and at the hearing, the company agreed to give it and also create a new four-party selective ringing service, and requested a net increase of 25 cents per month in the one and two-party residence rate and a gross increase of 25 cents per month in the other exchange rates, subject to a discount of the same amount for prompt payment. The improved service is already in effect.

The company has outstanding a capital stock fully paid up, of $20,100.00; it owes $2,250.00; has a depreciation reserve of $2,458.64, and a surplus of $4,021.69. The money represented by the last two items has been put back into the plant. The claimed book value is $26,016.09. With recent improvements, the present value of the plant may be worth at least 75% of the book value, or $19,511.50. No physical valuation was made. The net operating income, after deducting $1,200.00 for depreciation for the year 1915, was $1,511.59, and for 1916, $1,453.80, which represents a return upon the assumed present value of 7.9% for 1915, and 7% for 1916. The proposed rates, if applied to the business of 1916 would yield a net operating income of $2,662.79. After deducting 6% depreciation from the assumed present value there would be a balance of $1,491.00 for dividends and surplus, representing a return of 7.51% upon the present value, or 7.41% on the stock.

The company is furnishing a two-party business and a four-party residence service at the one-party business and two-party residence rates, respectively. This discrimination is unavoidable under the present schedule.

The proposed schedule creates a two-party business and a four-party residence rate and the service must be classified according to the schedule. The proposed schedule also increases the one-party business rate twenty-five cents per month gross, but these subscribers may continue to enjoy the old rate by availing themselves of the discount. It further provides that the residence subscribers who have been receiving four-party service may subscribe for such service at the rate that they have heretofore paid. The proposed schedule also increases the one-party and two-party residence rate fifty cents per month gross, with a discount of twenty-five cents per month for prompt payment and will yield to the company an increase in the net return of less than $200.00 per annum.

It is therefore ordered, that the Zumbrota Telephone Company, be permitted to establish the following reasonable maximum rates for local exchange service at Zumbrota, Minnesota, to become effective on the first day of October, A. D. 1917:

Business, one-party,	$2.25 per month gross
Business, two-party	1.75 per month gross
Business, extension	1.00 per month net
Residence, one-party	1.75 per month gross
Residence, two-party	1.50 per month gross
Residence, four-party	1.25 per month gross
Residence, extension	.50 per month net

All rates to be billed gross except where quoted net.

All gross rates to be payable monthly in advance with a discount of 25 cents per month if paid on or before the 20th of the month in which the service is rendered.

The petition of A. W. Anderson for the installation of a telephone in his farm residence by the St. James Telephone Company was heard, and upon consideration, the commission finds as follows:

A. W. Anderson for thirteen years has resided on his farm in the town of Nelson, Watonwan county, Minnesota, about seven miles from the city of St. James.

The St. James Telephone Company operates a local telephone exchange in the city of St. James and approximately 245 miles of rural lines in the vicinity. The company was organized in 1905, and now serves some 800 subscribers, about 400 of which are rural.

In 1907, the respondent constructed a telephone line upon the highway passing on the north side of the complainant's farm, and a telephone was installed in his residence at that time. The complainant continued to receive service until April, 1914, when he and numerous other rural subscribers, ordered their telephones removed because of an increase in the rate made by the respondent company. During the month of November, 1916, complainant made application for the re-installation of service by the respondent, and a telephone was installed early in December of that year.

The telephone company has a regulation in effect requiring at least two farm subscribers to each mile of pole line on its branch lines. The reasonableness of such a regulation is questionable. This rule seems to have been generally carried out except that since the time numerous telephones were removed because of the rate increase in 1914, certain rural subscribers have continued to receive service on branch lines where but one subscriber to the mile remained. It appears that at the time the telephone was re-installed for the complainant, he was informed by officers of the telephone company that the service was installed conditionally, dependent on the acquiring of one or more additional subscribers on the particular branch line serving Mr. Anderson. This branch line, although serving more than one subscriber prior to 1914, did not serve subscribers after that year, but was permitted to remain upon the highway, although allowed to deteriorate to the extent that at the time the telephone was re-installed in December, 1916, for the complainant, an expenditure of between $40.00 and $50.00 was required to place the line in proper repair.

It appears that shortly after the telephone had been installed for Mr. Anderson, his neighbor, a Mr. Sandmeyer, whose farm adjoins the farm of the complainant upon the south and west, made application to the respondent for service, which service was to have been supplied over the same branch line. Access to the Sandmeyer farm is over a private driveway across the farm of the complainant, and a dispute having arisen relative to the right of the telephone company to construct a telephone line over this private driveway to the Sandmeyer farm, resulted in the removal of poles on this driveway which had been set by the company, thus preventing the telephone company from giving Mr. Sandmeyer service so that the branch line referred to served only the complainant. Mr. Anderson having refused the telephone company permission to place telephone poles on the private driveway to serve Mr. Sandmeyer, it removed his telephone on February 12, 1917, on the grounds that it was then unable to serve more than one subscriber on the branch line. The length of the branch line from the main line to the entrance to the Anderson farm, is 2,380 feet.

The telephone company has since received an application for telephone service from a farmer living on the same highway and one-fourth of a mile west of the complainant, but to serve this applicant it will be necessary to extend the present telephone line that distance, a former line which was along this portion of the highway and previously served this applicant, having been dismantled.

The question of disputed right of way is one for the courts and not for the commission to decide. The telephone company is a public utility and is responsible for the acquiring of right of way where necessary to serve its applicants for service and none of its applicants or subscribers should suffer delay or the right of being furnished with service because of the inability of the telephone company to secure right of way to serve other applicants.

The telephone line is now, and has for a number of years been constructed to the house of the complainant and the only

additional expense required to furnish telephone service to the complainant is the installation of a telephone instrument. The complainant has offered, and is willing and able to pay, the rate for service required by the telephone company, and comply with all rules and regulations of the respodent in this matter.

It is therefore ordered that the St. James Telephone Company install a telephone in the farm residence of the complainant, A. W. Anderson, at the schedule rate for rural line service and furnish the same service as it furnishes to all of its rural patrons.

Application for higher rates is made by the Ivanhoe Telephone Company of Ivanhoe, the Villard Telephone Company of Villard and the Hendrum Telephone Company of Hendrum.

Kansas

A new accounting classification for use of telephone companies of Kansas is to be promulgated by the Kansas State Public Utilities Commission. The reasons for this action, according to a statement issued to all telephone companies operating in the state, is in order "to secure uniformity in the reports rendered to the commission by telephone companies, and to make such reports of greater value for comparative purposes."

"The Interstate Commerce Commission prescribes classification for class A, B and C companies," adds the statement, "and it will be the purpose of the commission to follow such classifications for the same class of companies in the state reports, with perhaps some amplification. As the Interstate Commerce Commission does not prescribe an accounting classification for class D companies, it will be necessary to adopt some simple classification that will furnish the necessary data.

"The commission desires that such classification of accounts as it may promulgate shall be satisfactory to the companies operating within the state, and that no undue burdens shall be placed upon them by reason of unnecessary requirements in this direction, and in order to accomplish this the commission requests that a representative of each of the telephone companies or as many as can make it convenient to do so, meet with the engineers and accountant of the commission at its offices in the state house at 10 o'clock a. m. September 26, for the purpose of drafting a tentative classification of accounts to be submitted to the commission for its approval."

Oklahoma

The corporation commission has granted the Comanche Telephone Company authority to raise the rates for its service in the town of Comanche to $2.50 a month for a special line service in the business district; $1.25 a month for special line service in the residence district, and $1.25 a month for rural lines. The rates become effective October 1.

Nebraska

A hearing was held by the railway commission on the application of the Dawson-Nemaha Telephone Company of Dawson for an increase of rates. The company has been charging $1 a month for all classes of service. It is asking for a business rate of $1.75 and a residence rate of $1.25.

New York

The New York Telephone Company has petitioned the public service commission for authority to issue $25,000,000 common stock to discharge outstanding demand notes, reimburse the treasury for expenditures from income for construction and provide for proposed construction and improvement of facilities.

Oregon

The Tillamook County Mutual Telephone Company has petitioned the public service commission for permission to increase its residence telephone rates from $1 to $1.25 a month and its business telephone rates from $1.50 a month to $1.75.

The Pacific Telephone & Telegraph Company has filed an application with the Public Service commission asking for permission to discontinue its long distance office at St. Paul, in Marion County. St. Paul is adequately served via Aurora, Hubbard and Newberg, it is declared.

J. B. Middleton, manager of the Home Telephone Company of Portland has asked the Public Service Commission if, under the arrangement whereby a commission of three months' free service is given for a new subscriber, the wife of the subscriber may receive the commission.

Pennsylvania

The Public Service Commission, in an opinion by Chairman Ainey, grants the application of the Bethel & Mt. Aetna Telephone Company for the acquisition of the Farmer's Telephone Company of Reistville. The protest of the Schaefferstown Telephone Company which is a competitor of the Farmer's company in the Heidelberg township field, failed to prevent the acquisition, the commission holding that competition in the district existed before the application was filed.

West Virginia

The Chesapeake and Potomac Telephone Company of West Virginia has mailed the following circular letter to its subscribers:

In about sixty days we shall be ready to combine the two existing telephone systems in Wheeling. The point has been reached where we shall know what service each of our subscribers will require. Our representatives will call upon you at an early date to tell you about the rates and learn your desires.

The new rates which follow entitle you to call Altenheim, Benwood, Elm Grove, Warwood, Wheeling, W. Va., Bellaire, Bridgeport, Martins Ferry and Shadyside, Ohio, without extra charge:

	Business per month	Residence per month
Individual line	$5.00	$2.75
Two-party line	4.00	2.25
Four-party line	3.50	1.75
Extension	.75	.50

Contracts are on an annual basis.

Montana

By an order issued from the office of the state railroad commission the Eureka Mutual Telephone Company, a regularly operating telephone utility in Lincoln County, was authorized to increase its rates 25 cents a phone a month and a new exchange rental schedule was ordered into effect after October 1.

The commission found the petition of the company justified following a hearing at Eureka July 16, during which it developed that there has been a large increase in the cost of operation since the company was organized five years ago.

Municipal Ownership Agitation

Meetings in several Columbus factories, as well as sessions of several labor organizations, are being held in furtherance of the campaign in favor of a municipal telephone system.

Those back of the movement say that they have nearly 5,000 signers to the petitions, asking a referendum on the issuance of $300,000 bonds for such a purpose. Many speakers have volunteered their services for the campaign, and an organization in each precinct of the city is planned.

Buckeye Machinists Union No. 59, endorsed the project after an address by John Moore, president of Ohio Mine Workers.

Moore, among other things, said:

The movement now projected in Columbus by the labor interests and many others who are and for many years have been in favor of municipal ownership of public utilities, should receive the support of all citizens.

The principle of municipal ownership is not new; it is as old as the theories and practices of municipal government. The right now guaranteed to us of home rule in municipal government, as provided by the constitution of the state of Ohio, and by the charter for Columbus, requires only the affirmative action by the voters to give us cheaper and better telephone service. This cheaper service would enable many thousands of our people to enjoy the convenience of the telephone.

It ought not require much argument to induce favorable action at the polls. Bonds have been issued for more than $2,000,000 or $3,000,000 to own our own electric light plant and waterworks plant. They all have proven wise and sensible investments. If a corporation can operate a telephone system at an enormous profit, surely the city can operate such a system at actual cost, thus saving thousands annually to the consumers or users of the telephone.

The franchise granted by the city to the Citizens Telephone Company and now owned by the Ohio State Telephone Company, provides for purchase by the city after giving one year's notice, but the price the city would have to pay for it would make the burden too heavy to carry.

The initiated ordinance should be supported and adopted and thus a long step would be taken toward the desired result. The next step, along the same line, would be to amend the Ohio constitution to provide for state ownership of long distance telephone service, and the universal connection of all telephones in Ohio, and to accomplish this, petitions will be circulated in various localities in the state. The people must protect their own interests, and to do so I am in hearty accord with any movement which will bring this about. We know that if the city owns the telephone business there will be no watered stock.

Wheeling Threatens Confiscation

All property within the corporate limits of the city of Wheeling of the old National Telephone Company of West Virginia, recently consolidated with the Chesapeake and Potomac Telephone Company, may be confiscated by the city according to local authorities.

This was brought out at a session of the council in a report of City Solicitor M. J. Cullinan, and the subsequent adoption of a resolution calling upon officers of both the National Telephone Company of West Virginia and the Chesapeake and Potomac Telephone Company to appear before the council and show cause why the property in question should not be forfeited to the city.

The grounds upon which Cullinan's report and the resolution are based are contained in an apparently almost forgotten section of the ordinance granting the National Telephone Company of West Virginia right to establish lines, conduits, etc., in the city, passed April 10, 1900.

This section—Section 13 of the ordinance—reads as follows:

This grant is upon the further condition that should the said National Telephone Company of West Virginia at any time combine or sell out in any manner whatsoever to the Central District and Printing Telephone Company or any other telephone or telegraph company, then and in that event all rights and privileges hereby granted shall immediately be forfeited, and the whole plant, system and property of the said National Telephone Company of West Virginia shall be forefeited to and confiscated by the city of Wheeling and shall cease in every respect to be the property of the said National Telephone Company of West Virginia.

In his report, which recited this section, Mr. Cullinan further stated that the board of directors of the National Telephone Company of West Virginia had accepted the ordinance in which this section was embodied.

Acting upon a recommendation in the solicitor's report, a resolution instructing the notification of officers of both the National Telephone Company of West Virginia and the Chesapeake and Potomac Telephone Company of the action of council, embodying a request that they appear at a regular meeting of council within thirty days and state whether the companies have been consolidated and show cause, if any, why the property of the National Telephone Company of West Virginia within the city of Wheeling should not be confiscated by the city, was adopted.

The resolution was passed unanimously and without discussion, but it is considered one of the most important undertakings of the new administration, as the property of the National Telephone Company in the city unquestionably represents a large sum.

American Telephone Well Financed

The present cash balance of the American Telephone & Telegraph Company is said to be close to $60,000,000. This is after allowing for the company's having bought in and anticipated $38,000,000 of subsidiary notes coming due in February next. It was to take care of the maturity of these notes as well as to provide for construction purposes that the 1916 financing was arranged. It still has to receive about $10.000,000 additional cash from the final instalment in connection with its 1916 stock issue. In addition to buying in these subsidiary notes the company has also purchased about $15,000,000 preferred stock of the Western Electric Company in order to provide that corporation with a working capital adequate to swing a gross business which this year is running at the rate of $150,000,000, or almost 45 per cent more than in 1916. One of the features of this year's operations has been the commendation which its efforts to render prompt war service to the Government have elicited from the Administration. The company has done things in a war way and has expended money freely to an extent that will be known only when the war has passed into history. The relations between the company and Government authorities have moved along with practically no friction and the policy of payment which the Govrenment has adopted toward this company has been fair and even liberal.

Keystone Statement

August gross income of the Keystone Telephone Company amounted to $132,327, an increase of $9,854 over the same month of 1916. Net after taxes was $58,000, or $1,255 above the previous year. Eight months' gross income was $1,040,000, or larger than the previous year by $77,483. Surplus after all charges and taxes amounted to $167,000, an increase of $6,597.

Telephone Patents Issued Recently

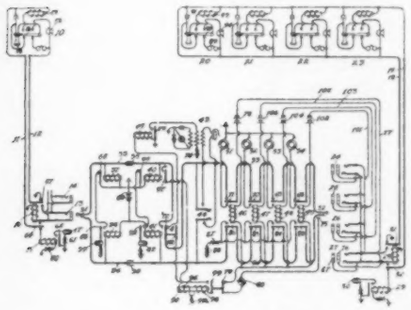
A Brief Digest of those Current Specifications Most Interesting to Telephone Men

BY DAVID S. HULFISH

NO 1,224,140. Automatic Testing System Issued to H. P. Clausen, assignor to Western Electric Company, Inc., New York, N. Y. An automatic switch picks up line after line in a telephone exchange and detects by test circuits any irregularities in the lines thus picked up.

1,224,161. Automatic Exchange System. Issued to C. L. Goodrum, assignor to Western Electric Company, Inc., New York, N. Y. (Application filed April 1, 1905.) The claims refer to the connections of the ringing relay at the connector switch in an automatic exchange.

1,224,374. Trunk Circuit. Issued to C. L. Goodrum, assignor to Western Electric Compay, Inc., New York, N. Y. A two-wire, two-way trunk between two automatic exchanges. A selector is found upon each end of the trunk and circuits always connect the trunk for service with a battery at one end only.



1,224,425.

1,224,425. Party Line Ringing System. Issued to Le Roy W. Stanton, Davenport, Iowa. With a Jack-per-station line, each jack has a selector wire running to a relay. The relay determines the selection of a proper ringing generator for ringing the station corresponding to the jack.

1,224,883. Universal Cord Pair. Issued to C. Mollerup, assignor to Automatic Electric Company, Chicago, Ill. A plug may be inserted into a jack of a local-battery line or of a common-battery line and complete supervision for either line is given, yet the plug has but one relay for the purpose. (Application filed January 2, 1909.)

1,225,291. Release-Signal System. Issued to F. M. Ward, G. H. Bryant and T. M. Inman, assignors to Relay Automatic Telephone Company, London, England. When an automatic-exchange connection is released, a busy-tone signal is sent to the telephone to signal the telephone user to hang up.

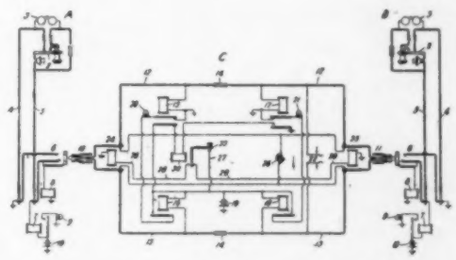
1,225,603. Measured-Service System. Issued to J. Erickson, assignor to Automatic Electric Company, Chicago, Ill. When a called party answers upon the automatic exchange the calling telephone is rendered useless until after registration of the call.

1,226,184. Selector. Issued to L. G. Bygrave, asisgnor to Relay Automatic Telephone Company, Ltd., London, England. A selector for automatic telephone exchanges, comprising a series of switching relays which may be left energized one at a time, each controlling impulse operating the next relay in order at the beginning of the impulse and then releasing the previously energized relay after the end of the impulse.

1,226,966. Selector. Issued to C. L. Goodrum, assignor to Western Electric Company, Inc., New York, N. Y. The selector has one level of selection, making long forward steps to select a group of lines and then short backward steps to select a line in that group.

1,226,981. Call Register System. Issued to A. E. Lundell and H. G. Eddy, assignors to Western Electric Company, Inc., New York, N. Y. The operator may listen in at will until she has registered the call, after which she cannot listen in, thus preventing second registration.

1,227,010. Ringing System. Issued to E. H. Smythe, assignor to Western Electric Company, Inc., New York, N. Y. The operator's ringing key rings upon either plug, when the receiver is on the hook.

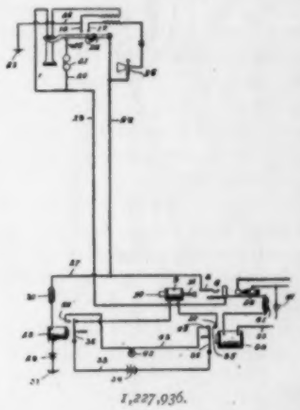


1,227,010.

1,227,474. Busy Test. Issued to T. G. Martin, assignor to Automatic Electric Company, Chicago, Ill. In an automatic exchange, a discriminating tone is given to inform an operator whether a tested line is busy, upon a call from a subscriber's line or from another operator.

1,227,609. Busy Test. Issued to C. L. Goodrum, assignor to Western Electric Company, Inc., New York, N. Y. When a connector is picked up from a subscriber's line, it refuses a busy line and returns to normal, but when picked up from an operator at a manual switchboard it stops upon the busy line and returns a special test signal.

1,227,932. Trunking System. Issued to F. N. Reeves and A. E. Lundell, assignors to Western Electric Company, Inc., New York, N. Y. When a receiver is lifted at an automatic branch office, the line is connected immediately to the main automatic office and if the dial operation determines that the called line is in the same branch office the trunk to main office is released and a local trunk is used instead.



1,227,936.

1,227,936. Plug Ejector. Issued to H. B. Rodier, Washington, D. C., assignor of parts to I. N. Boernstein, Paul Koester and R. G. Gotta. A solenoid behind the jack operates its plunger to push the plug out, the solenoid being included in a release circuit controlled by the telephone hook.

1,228,007. Fire Alarm System. Issued to John Erickson, assignor to R. H. Rogers, Rochester, N. Y. In an automatic exchange where the call sender never transmits more than ten impulses, a fire alarm sender is arranged to transmit eleven impulses to select a fire-alarm circuit at the central office, and then to transmit a fire-alarm box-number signal afterward.

1,228,537. Supervisory System. Issued to W. W. Dean, assignor to Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. In connection with a common-battery cord-pair, a separate recall signal is provided.

1,229, 165. Semi-Automatic System. Issued to H. D. Stroud, assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. (Application filed September 2, 1902.) Instead of an answering plug, an automatic switch searches for a calling line. The patent has an early filing date and carries 121 claims, some of them broad in scope.

Subscribers Ask New Switchboard

Havana, N. D., is agitating a boycott against telephones unless the Forman-Rutland & Havana Telephone Company gives better service. A petition was signed by all telephone subscribers and forwarded to the head offices of the company to the effect that no more rent would be paid until a new switchboard is installed. The subscribers claim that they were promised a new switchboard a year ago, and that there is no complaint made against the local management.

Brownwood District of Texas Meets

The Brownwood district meeting of the Independent Telephone Association of Texas opened September 14 in Brownwood in the rooms of the Chamber of Commerce on Brown street. This is one of six similar meetings held at Austin the 11th, at Temple, and at Waco, Greenville and Tyler or the 18th, 19th and 20th.

Representatives of practically every Independent telephone company within a radius of a hundred miles were present at the Brownwood meeting.

R. B. Still of Tyler, president of the state association, called the meeting to order and F. W. Greber, general manager of the West Texas Telephone Company and vice-president of the state association, was chosen chairman. Stanbury Alderman, general superintendent of the Western Telephone Company of Big Springs was chosen secretary.

Mr. Greber discussed the subject of co-operation, dwelling upon the relationship of the larger companies to the smaller ones. The fact that the public can best be served by mutual co-operation of companies was stressed. D. J. Johnson of Brownwood discussed the problems of handling traffic. R. B. Still of Tyler spoke at length concerning the aid rendered the United States government by the association in securing men to fill the signal corps battalion, bringing out the fact that Texas had furnished one complete company, all taken from active service with the Independent companies.

The meeting adjourned at noon for lunch. In the afternoon John Y. Rust of San Angelo discussed materials, Stanbury Alderman discussed revenue, and the opening of the question box closed the meeting.

The district meetings are held for the purpose of allowing the telephone men an opportunity to get together and discuss ways and means for providing the public with a better telephone service. The West Texas Telephone Company was host to those attending the meeting.

Registering during the session were: R. B. Still, president Texas Independent Telephone Association, Tyler; Stanbury Alderman, superintendent Western Telephone Company, Big Springs; D. J. Johnson, West Texas Telephone Company, Brownwood; L. W. Lawrence, Trickham Telephone Company; A. W. Weaver of Santa Anna; J. H. McKee, Brownwood; Jas. B. Whiteman, West Texas Telephone Company; T. M. Toombs, Stephenville; John Y. Rust of San Angelo; B. H. Cunningham, Brownwood; H. F. Smith, Blanket; L. B. Windham, Silver Valley; Frank L. Ruland, Brownwood; C. B. Mohler, Goldthwaite; Miss Dollie Ranne, Rochelle; Mrs. J. K. Baze, Rochelle; M. C. Atkins, Brownwood; W. E. Humphrey, Rochelle; Arthur Hall, Lohn; W. T. Moore, Santa Anna; W. W. Davis, Brownwood; E. G. Fahrenback, Stromberg-Carlson Telephone Manufacturing Company, representative; C. C. Briton, Winters; W. O. Hall, Lohn; M. L. Bean, San Angelo; F. W. Greber, Brownwood; D. H. Shilling, Buffalo Gap; H. P. Canady, Coleman; J. W. Cox, Gouldbusk; R. C. Carter, Brookesmith; Miss Ollie Phillips, Rochelle.

The Wires and the War

One aspect of the construction of the new army cantonments, aviation fields, naval bases and other government war projects to which attention has not been called is that of electric communication. Every one of these places must be in constant contact with Washington, and it must at least be possible to establish contact between any two of the stations. This involves a very heavy program of construction, enlargement and inflated operation, on the part of telegraph and telephone companies.

One of the biggest undertakings has been in connection with the "toll switchboard" at Washington, through which all long distance calls, both incoming and outgoing, must pass. The third addition since February is now being made here, and will, when complete, make the capacity of this board 220 per cent of what it was in the month mentioned. At the same time a great deal of local switchboard and cable work has been called for by the heavy increase in inter-department calls.

The location of the army cantonments in most cases some few miles from the nearest city has necessitated the installation of long cables containing from fifty to a hundred pairs of wires, putting the camp switchboard in contact with the national telephone and telegraph system at the city. In addition to all this permanent work, temporary facilities had to be furnished the contractors engaged in construction work. The demands upon the resources of the companies in the way of receivers, transmitters, batteries, and other items of small equipment can better be imagined than described.

The whole record of emergency work in establishing the communications which we have specifically mentioned, as well as those for aviation fields, bridge and water supply guards, manufacturing plants engaged in special war work, railroads involved in the movements of troops, coast defense projects, etc., has been a highly creditable one. The work of the telegraph and telephone companies touches the war at every point, and it is a striking tribute to the science of communication that a country so vast as the United States can be so closely knit together by its hundreds of thousands of miles of wire.

Telephone Time Service in Switzerland

Immediately after the outbreak of the European war the government of Switzerland suspended the operation of private wireless stations throughout that country. One result of this step was to prevent the receipt of the daily wireless time signals from the Eiffel Tower, in Paris, to the considerable inconvenience of the Swiss watch and clock makers, as well as many other persons who had been in the habit of receiving these signals. In order to remedy this situation, the federal telegraph and telephone service installed at Berne automatic apparatus, designed by E. Nussbaum, whereby the wireless time signal received by the official station at that place from Paris is conveyed over the telephone lines to telephone subscribers who desire it. This plan has been in operation since May, 1916, and astronomical observations made at the federal observatory in Zürich show that the accidental errors involved in the transmission of the signal rarely exceed a tenth of a second.

The two telephone exchanges in Foochow, China, serve 530 subscribers. The limit of the present switchboard capacity has been reached and facilities will be extended. A recent innovation is the employment of English-speaking operators for the convenience of foreign subscribers. The fee for the ordinary wall instrument is $60 Mexican per annum, and for the desk style $72 Mexican.

Of Interest to the Trade

What the Telephone and Accessory Manufacturers Are Doing to Advance the Art

The Phantom Coil

"In its certainty of accomplishment, its return of real profit, as well as the wonder of its mystery, the phantom coil portrays the romance of telephony. Its story, perhaps, knows no equal in the realm of the electric current."

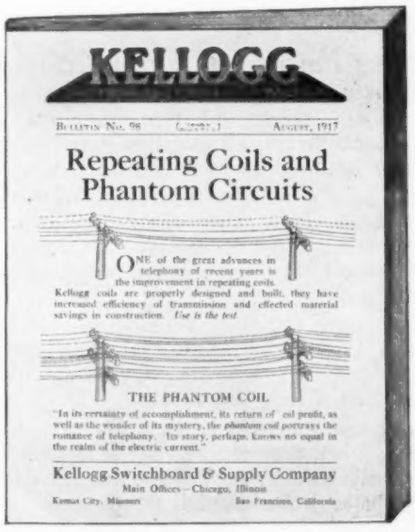
The above lines appeared recently in Kellogg advertisements with other descriptive matter and illustrations telling of the advantages of Kellogg repeating coils and phantom circuits.

As illustrated below the Kellogg Comany has recently issued a revised edition of its bulletin on repeating coils.

The number of inquiries resulting from this advertisement have been exceptionally satisfactory and the demand for these books is increasing. A great many Kellogg customers have continuously used Kellogg coils for years and know their value in actual practice and comparisons of line construction costs, with and without the Kellogg phantom coils.

There are in this bulletin, in addition to the halftone photograph reproductions of two of the most popular Kellogg coils, the actual coil diagrams and coil connections with drawn circuits showing exactly what the installation should be under the various conditions commonly met with in various types of exchange service.

This bulletin also contains chapters of phantom circuits and how to obtain phantom circuits on line



Kellogg Bulletin No. 98.

conditions and line transpositions. The latter subject is taken up at some length, and satisfactory types of transposition brackets are discussed and illustrated.

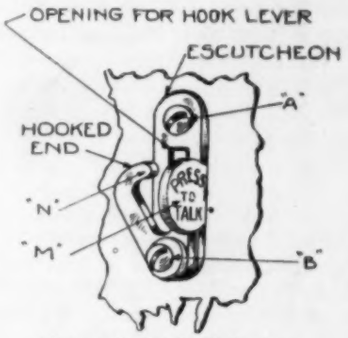
The chapter on phantom combinations includes complete illustrations of all practical working conditions.

This book will be found of interest and value to all practical men who are seeking to give the most efficient service in the most economical way.

The Kellogg Company will send a copy of this book to interested telephone men on request.

Saving Telephone Dry Batteries

A "battery saver" which, it is claimed, eliminates waste by permitting subscribers to use their telephones for listening purposes without connecting the dry cells to the transmitter circuit, and is arranged so that by



Battery Saving Latch in place.

pushing a button the telephone is immediately put in transmitting condition for talking purposes, has been developed by the Stromberg-Carlson Telephone Manufacturing Company of Rochester, N. Y. It consists of a latch device which is made to attach to the hook-switch escutcheon plate on the left side of the instrument. When the receiver is removed from the hook the lever springs up, but is caught half way by the bent finger of the latch device. In this position the circuits of the telephone are connected so that the user may hear but not talk; the transmitter is not connected to the battery and no energy is consumed. If the person using the telephone wishes to talk he presses the latch back. This disengages the hook-switch lever and allows it to resume its upward movement to the full operating position. When the lever is in this position the battery is connected to the transmitter and the telephone may then be used for talking purposes. When the receiver is replaced the device is automatically forced to its normal position.

A. A. E. Organizes Three New Chapters

The board of directors of the American Association of Engineers, at their meeting on September 5th, granted charters to the members in St. Paul, Indianapolis and Milwaukee. This makes a total of seven chapters which have been organized since the association was incorporated about two years ago. The total enrollment of the national organization is over twenty-two hundred different members.

A joint meeting of the association and the Detroit Engineering Society was held in the Commerce building Thursday, August thirtieth. It was the unanimous opinion of the engineers present that the Detroit Society should form a working co-operation with the American Association, as they have been carrying out a similar program locally for Detroit as the other organization has

operated in a national way. The Detroit Society has a total enrollment of about seven hundred members and if this working co-operation is established it will mean the furthering of the work laid out by the committee on engineering co-operation.

Membership in the American Asociation of Engineers is being extended to all technical engineers in military service without payment of initiation fee or dues. This is part of the co-operative plan to keep them advised as to progress in the engineering field and to give them personal assistance upon their return to their professional work.

Kellogg at Indianapolis

The sign of the desk stand again prevailed at the entrance of Room 818 of the Claypool Hotel, Indianapolis, Indiana, September 19 and 20, which, of course, could only mean that the Indiana Independent Telephone Association convention was again in full swing.

Looking through the doorway of Room No. 818 revealed a complete display of switchboards, telephones and telephone equipment.

The Kellogg Switchboard & Supply Company had its complete exhibit, consisting of magneto telephone, common battery telephone and grabaphone panels; eight illuminated display boxes, explaining the reason why Kellogg apparatus lasts a life-time; low type magneto, universal and P. B. X. switchboards; also the popular instantaneous recall switchboard, which was in operation for demonstration purposes.

The grabaphone panel proved very attractive; this type telephone was admired by all and is proving very popular.

Many telephone men were complaining of the high cost of batteries, and entering the Kellogg exhibit were told of the Kellogg telephone battery savers, which immediately interested the men because of its simplicity and practicability.

The badges given to the operators who attended the operators' school were considered a necessity after once in their possession. The badges consisted of a heavy white silk ribbon attached to a bar pin containing a small card giving the operator's name and address. Printed on the ribbon, in gold, was "Indiana Independent Telephone Association, September 19th and 20th."

A small celluloid mirror, ivory finish, with the Independent telephone shield printed in colors and the words "Operators' School" on the back, and containing a very useful bevel French plate glass, was attached to the bar pin by a small ribbon, which permitted the removal of the mirror after the convention.

These badges were furnished with the compliments of the Kellogg Switchboard and Supply Company.

Messrs. A. J. Carter, general sales manager; W. R. Brewer, manager supply department; B. H. Blake, state representative; F. L. Eldridge and Fred Seeley, sales representatives, and C. W. Nelson, advertising department of the Kellogg Switchboard & Supply Company, attended the convention.

"Duratax Cords" is the title and subject of a folder, envelope size, sent out by the Stromberg-Carlson Telephone Manufacturing Company. Bulletin No. 1015 is its official designation for the telephone men who will write and ask for it.

The Rochester Industrial Exposition

The Stromberg-Carlson Telephone Manufacturing Company and the Rochester Telephone Company recently made a joint exhibit at the Rochester Industrial Exposition, an annual event which is attended by a large percentage of the total population of Rochester and the surrounding rural districts.

As the exposition is intended to be more of an educational institution than a business-getting proposition, the two companies endeavored to show the public some of the features of both the operating and manufacturing branches of the industry. To this end the Rochester Telephone Company installed a switchboard in one part of the booth so that passers-by might observe the operation of the private branch exchange which gave service to all parts of the grounds. Several pay-station booths were installed in the display space for the convenience of spectators desiring to communicate with friends and relatives in the city.

The Stromberg-Carlson Company exhibited a representative line of its products and used as a central attraction a large display panel showing all of the apparatus used in a central energy exchange in actual operating condition. By means of this demonstrating panel the various steps in the progress of a telephone call from one station to another were shown in detail. Subscribers displayed a keen interest in the way the lamps flashed on the switchboard and how the operators were able to make quick, accurate connections between the various lines terminating in the exchange.

Many of the complaints received by telephone companies can be traced to the subscribers' ignorance of actual operating conditions and it is certain that exhibitions and demonstrations conducted along educational lines will more than repay any operating company that will take the trouble to explain the workings of their exchange to the telephone-using public.

Business Rates for Boarding House

The Supreme Court of Missouri upholds the Columbia Telephone Company of that state in charging a higher rate for a telephone installed in a boarding house or a rooming house than in a private house.

Columbia is a college town and is speckled with boarding houses. In some of these establishments there are from three to thirty occupants. An extra charge of 50 cents a month was imposed on boarding houses and rooming houses.

The telephone company refused to place telephones lower than 3½ feet from the floor for the reason that if telephone users could sit down they would use the telephone more than if they had to stand.

The corporation declared that some of the residents of Columbia, when they went to the telephone were likely to make an all-day affair of a conversation if they had half a chance, and that until the "stand-up" order went into effect it was the custom in Columbia to "visit" by telephone.

The basis of assessment of telephone and telegraph companies has been raised by the Montana state board of equalization.

The state board decided to raise the rate for one copper wire from $85 a mile to $100 a mile. Each additional copper wire will be $25, the former basis of valuation. The valuation of each iron wire was raised, however, from $5 to $10 a mile.

Court Orders Connection at Owatonna

The telephone case decision by Judge Childress, in the Fifth district court at Owatonna, Minn., rendered in what was accepted to be a test action, was that the Northwestern Telephone Exchange Company must pass over its toll lines to its subscribers' Tri-State long distance calls. And for the service thus rendered by the Northwestern an extra allowance of 5 cents is to be charged.

It is the belief that the finding of the District court at Owatonna will be appealed.

The decision by Judge Childress in the case brought by the city council of Owatonna to compel the Northwestern to accept and deliver Tri-State toll messages virtually affirms the Minnesota Railroad and Warehouse Commission's order which stipulated physical connection. But that part of the order which imposed an additional toll of 10 cents is reversed.

The case is the first one on record in the state where physical connection was sought by a municipality between two competing telephone companies and the decision of the Railroad and Warehouse Commission was awaited with much interest by every city in the state which is served by both the telephone companies.

In June, 1916, the city council of Owatonna petitioned the State Railroad and Warehouse Commission to order physical connection for all Tri-State telephone toll calls to Northwestern telephone subscribers. After time had been given counsel for companies to prepare their briefs, the commission ordered the physical connection in February, 1917, and provided that a charge of 5 cents should be made by the Northwestern Telephone Exchange company, in addition to a further charge of 10 cents for each toll call from the Tri-State lines to a Northwestern Telephone company subscriber.

Both companies appealed from the decision of the commission as to the toll to be paid by the calling party, and the decision handed down by Judge Childress established, so far as the district court is concerned, the legality of the connections order, but removes the 10 cent tax, leaving but 5 cents to be paid by the Tri-State subscriber on a toll call over the Northwestern Telephone Company's lines.

Studying Physical Connection

In accordance with plans outlined by the city council of Grand Forks, N. D., to investigate as to the advisability of establishing a physical connection betwen telephone lines, a committee comprised of Mayor James A. Dinnie, City Attorney George A. Bangs and Alderman W. S. Whitman, departed September 21 for points in Minnesota and Wisconsin where they are conferring with municipality officials and data is being gathered.

In his anual message to the city council, Mayor Dinnie recommended that the city council take up and consider the question of physical connection between the two telephone companies carrying on long distance and toll business in the city. This message was presented to the council in April, 1917, and on May 7, 1917, the council adopted a resolution authorizing the mayor to appoint a committee to investigate the qnuestions connected therewith.

The mayor appointed W. S. Whitman as chairman, and Aldermen Turner and Kleven, with Messrs. Owen Young and F. L. Goodman, as such committee, to be aided by the city attorney. Alderman Turner was elected as secretary.

The committee carried on considerable investigation by correspondence with cities such as LaCrosse and Janesville, Wis.; Owatonna and Thief River Falls, Minn., and with the railroad commissioners of Minnesota and Wirconsin, and reported to the council on August 6, 1917, whereupon the council authorized the mayor, the chairman of the committee and the city attorney to make a personal investigation at the city's name, with other if deemed advisable, and at the offices of the different railroad commissioners for the purpose of ascertaining the desirability of such physical connection for local or long distance and the elements or factors going to make up a reasonable charge therefor.

The question of an adjustment between the different systems of compensation for the service thus rendered is somewhat complex and has created considerable litigation in almost every place where physical connection has been brought about.

If satisfactory rates can be obtained physical connection will not only be of vast convenience to the people of the city of Grand Forks but in addition it will result in very large savings.

Normal Times

A prominent New York national bank, noted for its accurate deductions in economics and finance, believes that business men, investors, corporations, who are planning constructive moves but who are waiting for the return of "normal times" before making a start, should take pains to discover just what are normal times.

On one of its illuminating advertisements, this bank carries its thought to the general public, as follows:

"We are all awaiting the return of normal times; in fact, we are always awaiting the return of normal times, but what are normal times?

"Look at the barometers of our basic industries, records of continuous advances in production, with depressions from time to time, of course, but each succeeding wave rearing its crest higher than the one before.

"Who can place his finger upon the normal of the steel industry? Certainly we do not expect to return to the production of twenty years ago, ten years ago, or even five years ago.

"There are people who contemplate investing in building or securities, and they propose to defer their operations until normal times. The prices of materials and securities may, indeed, at some future date decline to former levels, but we doubt if the prospective investors will consider conditions normal when that happens."

American "Pep" Improves Service

Norman Hapgood, the American war correspondent, in a recent cable dispatch says: "The most far-reaching influence that will be left on France by this war is that of the American business man and his methods of industry and organization.

"An American officer landed from one of our ships at a certain port in France. He hurried to a post office to telephone to paris. 'Your number,' said the employe, 'is twenty-three.' 'What do you mean by that?' the officer inquired. 'There are twenty-two ahead of you.' 'How long will it take?' 'They average about ten minutes apiece.'

"The officer departed. Five days later there were nine new telephone lines to Paris from that port."—*Telephone Topics.*

Night Service Difficulties in Washington

J. F. Goldbach, manager of the telephone exchange at Medical Lake, Wash., in a recent edition of the Medical Lake paper, had a signed article explaining the closing of the exchange at night, in which he said:

"This was made absolutely necessary by the action of the welfare commission of labor in preventing the day operator from sleeping in the office to answer emergency calls during the night."

Members of the state industrial welfare commission say Manager Goldbach was granted additional time to get an experienced girl from Spokane, as he said he could get no competent help at Medical Lake. When the time expired and no relief girl appeared the commission declined to permit any further extensions.

The Medical Lake Telephone Company having discontinued night service because of the demands of the state industrial welfare commission, citizens with the help of farmers are trying to arrange for some kind of service during the night.

Brevities of the Business

The Activities of the Whole Telephone Field Told in Short Paragraphs

PERSONAL NOTES.

T. E. Keltner, for forty years in the employ of the Central Union Telephone Company and its predecessors, and for twelve years plant chief in Peoria, Illinois, died very suddenly at his home in Kankakee, to which city he was transferred five months ago. His death is attributed to acute indigestion. He is survived by his wife and several brothers.

John M. Winslow, sixty-one years of age, one of the pioneer telephone builders of the state of Washington, recently died at his country home near Silver Lake, Snohomish county. Mr. Winslow was born in Philadelphia. As a civil engineer he was engaged for a number of years in Mexico. Going to the Pacific Northwest he settled in Tacoma, and fifteen years ago he went to Seattle to reside. Shortly afterward he purchased an interest in the old Independent Telephone Company in Everett, eventually becoming manager of the concern. When the Independent Telephone Company consolidated with the Puget Sound Telephone Company, operating in Snohomish and Whatcom counties, Mr. Winslow became secretary-treasurer of the new company. He held this position and was active in the company's affairs up to the day of his death.

S. C. Wentworth of Corpus Christi, Tex., has been assigned to Kingsville as manager of the local office of the Southwestern Telephone and Telegraph Company, while O. Stevens, the former manager, has been transferred to San Antonio as telegraph and repeater man. While in Kingsville, Mr. Stevens made many friends who wish him much success in his new home.

Elbert F. Norton, sales engineer with the Standard Underground Cable Company's Chicago office, has received a commission as major in the Engineers' Reserve Corps, U. S. A., and has left for three months' training at Fort Leavenworth, Kan. Mr. Norton is a graduate of Purdue University in electrical engineering. He has been with the Standard Company about five years and previous to this employment was an erecting engineer of electric and steam power plants.

The Southwestern Bell Telephone Company has employed C. O. Bentley, of Wichita, Kansas, as manager of the Eureka exchange, to take the place formerly occupied by W. B. Oliverson, who resigned to attend the second officers' training camp at Ft. Sheridan. Mr. Bently has been with the Bell company for a number of years and is thoroughly familiar with telephone work.

Albert Gallatin Wheeler, Sr., multimillionaire and builder of the Illinois tunnel, died at his home, 5240 Sheridan road, Chicago. He was 63 years old and had been declining for the last six months from a complication of diseases following a nervous breakdown. Surviving Mr. Wheeler are his wife and two children, Mrs. E. W. Gearhart of Scranton, Pa., and A. G. Wheeler, Jr., of New York City. All were with him when he passed away. Mr. Wheeler had done things in a big way for many years. He was born in New York April 27, 1854, and received the A. B. degree from the college of the City of New York in 1868. On February 12, 1873, he married Miss Cassie Gould Taylor of Allentown, Pa. For ten years, from 1869 to 1879, Mr. Wheeler was in the produce transportation business in New York, and then became identified with the construction of telegraph lines, railroads, underground electric traction systems at Washington and New York. His Chicago connection began with the introduction of automatic switchboards for telephone service and building tunnels under the streets of Chicago to be used as a transfer system for freight and as a terminal for railroads. It was in 1899 that Mr. Wheeler came to Chicago to live. He became president of the Illinois Tunnel Company, the Illinois Telephone and Telegraph Company, the Illinois Telephone Construction Company, a director in the Automatic Electric Company and interested in many other corporations. In politics Mr. Wheeler was a Republican. He built a handsome home on Sheridan road, which attracted attention because of the costly interior decorations, but a year or more ago sold this home after his two children had married and moved to other cities.

Morris H. Gref, a pioneer lineman, who laid the first telephone wires between Manhattan and the old city of Brooklyn, died at his home, 39 Cornelia street, Brooklyn, New York. Mr. Gref was 60 years old, and as a boy was a messenger for the American District Telegraph Company. Later he joined the Metropolitan Telephone Company. When the Postal Telegraph and Cable Company came into existence Mr. Gref joined that company, and changed the system from battery to dynamo, and installed most of the stations west of this city to Chicago.

E. E. Hoover, manager of the local branch of the Southwestern Bell Telephone Company of Kansas, who has been called by the army draft, will be succeeded by C. B. Spangler of Joplin, Mo., who will be manager for the company in Chautauqua county. Mr. Spangler has had fifteen years telephone experience and for the past two years has been straightening out difficulties between the company and patrons in this district. Sedan and Chautauqua counties should enjoy the best possible service under his management that the exigencies of war will permit.

NEWS FROM THE FIELD

CALIFORNIA

The Pacific Telephone and Telegraph Company has appropriated $59,920 for additional lines and equipment in Stockton and in the Stockton territory, which includes all of San Joaquin county and portions of Calaveras, Stanislaus and Tuolumne counties. New long distance circuits are to be run between Stockton and Sacramento, and between Stockton and Lathrop. There will be a new circuit from Lathrop through Ripon to Jamestown, another from Stockton to Fresno; another from Lathrop to Modesto, and from Modesto to Turlock. In the central office in Stockton added equipment is to be installed at a cost of $23,140. In addition to the above amounts $35,000 is to be expended in Stockton in laying new cables and making additions to the lines.

The contract for the new Sunset Telephone building to be erected at No 425 Brand boulevard, Glendale, will be awarded. The structure will be of reinforced concrete, thoroughly fireproof, and the first building of the kind in Glendale. It will have three stories and basement, with a frontage of fifty feet. The front will be of pressed brick and architectural terra cotta and much of the inside will be of beautiful marble finish. Thirty-five tons of steel rods will be used in the construction of the building, which, when completed and fully equipped, will cost in the neighborhood of $135,000.

Charles H. Button of Lebanon, Oregon, has purchased the controlling interest in the Lindsay Telephone Exchange, at Fresno, from A. M. Robertson. Mr. Robertson, who is also secretary of the Lindsay Chamber of Commerce, will move to San Francisco, where he will engage in business. He came here about six years ago, and re-organized the local exchange, which is now considered one of the best properties of the kind in the valley. It was recently re-constructed with a new exchange building and new equipment. Mr. Button is an experienced telephone man, having developed some of the best exchanges in the northwest.

COLORADO

Telephone service from Greeley to Keota and surrounding country was greatly im-

proved when the new Mountain States line between Briggsdale and Keota was put into operation. Before the completion of this line service from Greeley to Keota was by way of Grover, and the service at times was very faulty. The new line was put in by the construction gang working out of the Greeley office. It was started early this summer.

FLORIDA

Supt. J. F. Vaughan and Superintendent of Equipment A. P. Jordan of the Peninsular Telephone Company, made an inspection of the lines of the company preparatory to putting in new metallic telephone circuit between Clearwater and St. Petersburg and also preparatory to the installation of a new telegraph wire from the Postal Telegraph Company between Tampa and Clearwater over the poles of the Peninsular Telephone Company. The addition of the extra wire between Clearwater and St. Petersburg will really add two telephonic circuits between those cities, as the company will be able to install a "phantom circuit" between this city and the Pinellas county capital.

IDAHO

The Mountain States Telephone & Telegraph Company has purchased all of the interests of the Valley Telephone company, operating an exchange from Hansen, the consideration given being $4,200. The Valley company served about fifty subscribers. Lawrence Hansen was president and John Frahm secretary of the Valley company.

ILLINOIS

The Mississippi Valley Telephone Company of Carthage, Orville F. Berry, president, and the reorganization committee of the Western Illinois Telephone Company filed a joint petition with the public utilities commission asking for authority for the Mississippi Valley Telephone Company to purchase of the Western Illinois Telephone Company the exchange of Bowen, the toll lines from Macomb to Loraine and from Bowen and Camp Point and all stub lines off the toll line between Macomb and Loraine, and to issue first mortgage six per cent gold bonds to the amount of $8,000.

INDIANA

The Citizens' Telephone Company has elected the following new board of directors: E. X. Ehinger, Leo Yager, George Kinzle, F. M. Schirmeyer and John W. Tyndall. Messrs. Yager, Kinzle and Tyndall are new members, succeeding J. S. Bowers, J. T. Merryman and Dyonis Schmidt. The board will meet soon and elect officers.

The Wakarusa Telephone Company has sold the exchange to the Home Telephone Company of Elkhart. The consideration is said to have been $20,500 cash.

The Automatic Telephone Company has just completed a new circuit to Epsom, which enables patrons at Epsom to call direct to Washington. This line is now in use. This company now has a force of men employed building a second circuit between the city and Montgomery. When this new circuit is completed it will be possible to give even better service than at present.

The Home Telephone Company of Goshen and Elkhart has bought the exchange of the Wakarusa Telephone Company and will take over the plant in a short time. The consideration is said to have been $20,500 cash. The Home Telephone Company owns the Elkhart and Goshen exchanges, both of which have many rural patrons. The purchase of the Wakarusa exchange is in keeping with the Home Telephone Company's policy of increasing its scope of service.

IOWA

The Prescott Mutual Telephone Company held a business meeting and election at the Lyric. The following officers were elected: Homer McIlravy, president; Jas. Krisinger, vice-president; R. E. Brown, secretary; F. A. Outhier, treasurer. Following are the five directors elected: C. L. West, Ernest Rogers, Albert Grundman, Guy Green and T. M. Johnson. The present operators, Mrs. W. E. Keever and Mrs. Frank Florence, were retained with an increase in salary.

KANSAS

General Manager P. H. Hopkins stated that the announcement made by Vice-President E. D. Nims, of the Southwestern Bell Telephone Company, at Topeka, that the company would establish headquarters for the state of Kansas at Topeka, will not materially affect the organization of the company at Kansas City. Mr. Hopkins stated that Kansas has always been operated by divisions, with headquarters at Topeka, Wichita and other large points in the state, and that only general supervision was given the state from Kansas City. The demands of Kansas City and its territory have grown so materially within the past few years that it has been found advisable to supervise the company's Kansas business from Topeka, and allow the general manager at Kansas City to devote all of his time to Kansas City and its territory in Missouri.

KENTUCKY

Under the contract by and between the city of Frankfort and the Cumberland Telephone Company last year the latter corporation is to erect a handsome three-story building for use as offices and an exchange, and at the same time to put all of its wires under ground in the business part of the city and as far as the corner of Second street and Capitol avenue in the residential portion of the South Side. The foundation of the building is now being put in and the work of laying the conduits will begin soon. The work will be in charge of Mr. J. T. Featherstone of the construction department of the company, and the lines will be run east from the site of the building on Main street to the foot of the hill at Hill street; on St. Clair from Broadway to the Bridge and on Bridge and Second to Capitol avenue to the alley running north and south by the side of the building will be utilized to lay conduits to carry the wires to the South Side and to the northern part of town. It is the idea to begin the work before the contractor who is awarded the work of laying asphalt on Main and St. Clair streets and keep far enough ahead to be out of his way.

The Whitesburg Telephone Company is planning to build new lines connecting at Seco, Fleming, McRoberts and Jenkins in the coal fields.

MICHIGAN

Stockholders of the Citizens Telephone Company at their annual meeting re-elected directors: Robert D. Graham, Charles E. Tarte, Percival B. Garvey, John B. Martin, Cyrus E. Perkins, Victor M. Tuthill, Gaius W. Perkins, Walter C. Winchester and Willard K. Spencer, Ionia; Thomas Bromley, Jr., Muskegon, and Frank E. Church, Lansing.

At a meeting of the board of directors of the Michigan State Telephone Company the regular quarterly dividend of $1.50 per share was declared on the preferred stock, to be paid September 29, 1917, to the stockholders of record at the close of business on September 24, 1917.

MISSOURI

The Home Telephone Company is expending $10,000 on improvements in Galena, Baxter and Columbus. The company is now increasing the number of circuits between Baxter and Galena from four to seven to handle the increased business as the result of mining activities around Baxter. Three circuits will be added to the two between Baxter and Columbus to increase the efficiency of the service between those towns, and an addition of four lines will be made between Joplin and Galena, which will make ten circuits between those cities. The purchasing of equipment for these improvements has already been attended to and the work will progress rapidly.

MONTANA

The farmers' telephone line extending south of Froid into the Russian settlement has been completed and is in complete working order. The line runs south for a distance of about 28 miles, and serves a large number of farmers. The surrounding country is now well equipped with a network of telephone lines extending in all directions from Froid, and all the rural lines are kept up in splendid condition and no complaints are registered by patrons because of lack of prompt and efficient service.

NEBRASKA

The Lincoln Telephone & Telegraph Company have put in copper toll lines from Osceola to Polk and from Stromsburg and Osceola to York. This will greatly improve the toll service on these lines. In addition to this they will put in a new cable from the exchange to the cemetery and another reaching to the bridge on the south of town.

NEVADA

The Mason Valley Telephone and Telegraph Company, which has organized to furnish service to the Yerington district, has bought a quantity of material from the Nevada Telegraph and Telephone Company and will begin work at once on constructing extensions to its lines. The lines will eventually extend through Mason Valley, taking in Schurz, Wellington, Thompson, Wabuska and Yerington.

NEW HAMPSHIRE

Telephone communication has been established between the Isles of Shoals and the mainland and the first message over the cable of 12 miles was the greetings sent by Captain S. R. Sands, superintendent of the first guard district, to Captain George B. Ricker of the Appledore Island coastguard station. The cable will be used exclusively for the coastguard work and in connection with the first naval district.

NEW YORK

The Cattaraugus Union Telephone Company has filed a certificate showing that it has increased its capital stock from $50,000 to $75,000. The certificate is signed by Frederick Huntington as vice-president and C. J. Rich as secretary.

New York Telephone Company has petitioned public service commission for authority to issue $25,000,000 common stock to discharge outstanding demand notes, reimburse treasury for expenditures from income for construction and provide for proposed construction and improvement of facilities.

The New York Telephone Company is endeavoring to lease suitable quarters, centrally located, in La Salle, for the establishment of a local telephone exchange, and

thus do away with the present arrangement whereby all La Salle calls go through the Niagara Falls exchange, four miles away. The new brick business block adjoining the post office, and owned by Mr. Goodridge of Newfane, is receiving consideration in regard to these plans. There are between 350 and 400 "Bell" telephone subscribers in La Salle, at the present time.

OHIO

To provide for the erection of a new exchange building and for the installation of an automatic telephone system, the Elyria Telephone Company increased its capital from $200,000 to $350,000.

The Central Union (Bell) Telephone Company will erect an exchange building at New York avenue and Erie street, Toledo. The building and equipment will cost $105,000. A. J. Mellen, district manager, said the new branch will relieve the main exchange and will give North-end and Point Place subscribers better service.

Bell Telephone Company through its Chesapeake and Potomac divisions, will take over independent lines in eastern Ohio and northern West Virginia.

OKLAHOMA

Manager G. R. Potter of the Okmulgee office of the Pioneer Telephone Company, announced that the contract for the erection of the new telephone building on Seventh street, near the Parkinson Hotel, had been let to the firm of Rhinehart & Donovan of Oklahoma City. The erection of the building will be begun at once, according to Manager Potter. The cost of the building will be about $47,000 and the cost of the building and equipment will be about $150,000.

OREGON

Permission has been granted the Pacific Telephone & Telegraph Company by the public service commission to discontinue its station at Flanagan, in Wasco county. The commission found that the company's patrons were adequately served from Maupin.

PENNSYLVANIA

Nearly $5,000 has been expended by the Bell Telephone Company of Pennsylvania according to Local Manager W. H. Fetter of Harrisburg, for the construction of one physical circuit over the Harrisburg-York line. The construction of this line included the stringing of twenty-one circuit miles of copper wire and the changing of 271 crossarms for six pin crossarms to ten pin crossarms and the replacing of 18 poles. This additional circuit was necessary in order to avoid extensive rebuilding of the American Telephone and Telegraph Company's lines.

SOUTH DAKOTA

The Pioneer Independent Telephone Company has been formed and will be incorporated at $15,000 and a line built from Faith to Marcus.

TENNESSEE

The new telephone exchange building at Chickamauga has been completed. The telephone company is to put on a twenty-four-hour shift installing the exchange equipment, and it is believed that the new station will be ready for service within ten days. This exchange will be operated separately, just as the Hemlock now is, and nine girls and a supervisor will be employed there.

WISCONSIN

The Chippewa Valley Telephone Company has under way the entire rebuilding of its plant at Ladysmith. Over $11,000 is being expended in extensions and improvements. Wherever practicable cables are being installed instead of individual wires, and the lines are being moved off the streets to the alleys. The following amount of cable is being installed: 6.625 feet with 25 pairs of wires; 4,393 feet with 50 pairs; 4,007 feet with 100 pairs; 443 feet with 200 pairs; 783 feet with 300 pairs; 185 feet with 600 pairs. Ladysmith now enjoys the distinction of having the biggest aerial telephone cable in the state, this being the first one to contain 600 pairs of wires. Extensive additions are also being made to the switchboard to take care of the rapidly growing patronage. Next year the central plant will be moved to more roomy quarters and the system of individual phone batteries will be changed for the modern central power system. It will then be unnecessary to turn a crank to call central, simply take down the receiver—just like a self-starting car.

The telephone service between Eau Claire and Durand has been improved recently. Formerly it was necessary to talk through Menomonie but now there is a direct wire to Eau Claire from this city.

The state crew of the Bell Telephone Company at Eau Claire have been engaged in substituting cables for the network of telephone wires which until recently have been strung along Grand avenue on both sides of the river. The men have erected cables now from Fifth avenue to the office on Farwell street.

INCORPORATIONS

The Eldorado Telephone Company, Eldorado, Illinois, capital, $10,000; incorporators, W. T. Westbrook, James Lyon and J. C. Dodd.

Brown Telephone Company, Wilberton, Illinois, capital, $1,500; incorporators, R. W. Brown, O. L. Brown and Annie Brown.

Locust Grove Telephone Company, Kennard, Ind., capital, $10,000. To maintain and operate telephone lines and exchanges. Directors: Ambrose E. Barnard, Brooks Byrket and John J. Hardin.

Killdeer-Grassy Butte Telephone Company, Killdeer, North Dakota, capital, $5,000; to build 29 miles of line at an estimated cost of $1,500 to $3,000; incorporators, Robert Wilcox, E. P. Merrill, John E. Grande and D. J. Price of Killdeer and Sam Glerup of Grassy Butte.

Thorne Telephone Company, Thorne, North Dakota, capital, $25,000; to build 28 miles of line at an estimated cost of $2,700; incorporators, Francois Granier, R. A. Darling, Joseph Renauld, Joseph Darling, R. A. Nordbye.

The local exchanges of the Grayson Telephone Company and the Southwestern Telephone Company at Howe were consolidated at Howe, Texas.

Fairy Telephone Company, Fairy, Hamilton county, Texas, capital stock, $300, all paid in. Purpose, to maintain a telephone exchange; incorporators, Ernest R. Eudaley, Ben Gleason, J. H. Davis, Sid Dickerson and L. E. Moore.

Cecil Telephone Company of Grafton, West Virginia, to operate telephone lines in Knottsville district, Taylor county; capital stock, $5,000; incorporators, E. T. Colebank, J. H. Alexander, W. S. Rogers, Howe R. Knoppe and Camden Swisher, all of Grafton.

Articles of incorporation have been filed by the Youngs Telephone Company of South Carolina, with a capital stock of $1,000. The incorporators are W. P. Harris, Frank Abercrombie, Frank Clark, B. G. Harris and W. O. Sutton.

Articles of incorporation have been filed by the Maple Valley Telephone Company of Morristown, Tenn., with a capital stock of $1,000. The incorporators are W. D. Massengill, George E. Francisco, S. K. Graham and others.

The Beach Telephone System at Miami, Fla., has been incorporated with $25,000 capital stock. The officers are H. T. Whaler, president; J. T. Sanders, vice-president; U. O. Thompson, secretary.

The Eldorado Telephone Company of Illinois has been incorporated with $10,000 capital stock by W. T. Westbrook, James Lyon and J. C. Dodd.

The Metropolitan Telephone & Telegraph Company of Springfield, Ill., has been incorporated with $5,000 capital stock by H. Lee Sellers, James Dalton and John Syvert.

The Beard Co-Operative Telephone Company of Frankfort, Ind., has been incorporated with $1,500 capital stock. The directors are Wm. E. Rice, D. A. Catron, J. M. R. Hendricks and P. A. Thomas.

The Locust Grove Telephone Company of Kennard, Ind., has been incorporated with $10,000 capital stock. The directors are A. E. Barnard, Brooks Byrket, J. L. Hardin, Norman Harter and John Mullen.

Articles of incorporation have been filed by the Buffalo Creek Telephone Company of Upton, Wyo. The company is capitalized at $1,000 and the directors are E. I. Brainerd, R. G. Acord and Clarence Williams.

The Brown Telephone Company, at Vandalia, Ind., has been incorporated with $1,500 capital stock by R. W. Brown, O. T. Brown and Annie Brown.

The Lashley Telephone Company, at Bee Spring, Ky., has been incorporated with $500 capital stock by Charles, P. V. and Porter Lashley.

Articles of incorporation have been filed by the Goldstone, Rudyard & Brinkman Rural Telephone Company of Montana with $40,000 capital stock. The incorporators are E. Koefod, J. V. Stevens, O. Sanda and others of Rudyard.

Articles of incorporation have been filed by the Eastern Telephone Company, at Robersonville, N. C., with a capital stock of $20,000. The incorporators are S. L. Ross, R. J. Nelson and N. S. Ross.

Articles of incorporation have been filed by the Mount Scott Rural Telephone Company of Oklahoma with $1,000 capital stock. The incorporators are Owen Metcalf, A. P. Shrover, W. H. Willett and D. E. Oswalt, all of Lawton.

The Amelia County Telephone Company of Jetersville, Va., has been incorporated with $3,000 capital stock by A. A. Anderson, president, and J. M. Habel, secretary.

The Farmers Telephone Company of Carlock, Illinois, has been incorporated with $5,000 capital stock by Milo P. Lantz, C. R. Conger and Daniel Augstin.

Articles of incorporation have been filed by the Farmers Telephone Company of Hancock county, Kentucky. The company is capitalized at $144 and its incorporators are J. D. Rice, O. D. Rice and E. D. Rice.

The War Creek Telephone Company of Kentucky has been incorporated with $500 capital stock. The incorporators are A. J. Howerton, L. T. Roman, T. H. Easterling and Thomas Adams.

The Antreville Telephone Company of South Carolina has been chartered by the state to build telephone lines and operate an exchange in Antreville. Incorporators are R. A. Keaton and F. A. Carwell.